Polk County Conservation
Water Quality Monitoring Program
2016-17 Annual Report

December 1, 2017

Polk County Conservation
11407 NW Jester Park Drive
Granger, Iowa 50109
www.leadingyououtdoors.org

POLK COUNTY CONSERVATION

Table of Contents

Project Summary

In November 2012, voters supported the Polk County Water and Land Legacy Bond (PCWLL) in historic fashion, passing the measure with 72% support. This large margin of victory clearly shows that there is strong support for critical water quality, wildlife, trails, and recreation projects. In part, this bond has allowed Polk County Conservation (PCC) to start a water monitoring program to help assess watershed quality in Polk County, Iowa. The Polk County Conservation Water Quality Monitoring Program (PCCWQMP) began in the spring of 2015. The goal of this monitoring is to design and implement a series of biweekly monitoring events that will assess the water quality of watersheds within Polk County. Specific objectives of these events include to establish a baseline for determining stream health based on chemical, physical, habitat and biological parameters, to assess the health of the local watersheds, to target areas in need of water quality improvement, to create partnerships in order to grow our water monitoring program and to better understand the needs of our watershed system within Polk County. To achieve these objectives PCCWQMP, working with IOWATER and the Iowa Department of Natural Resources (Iowa DNR), selected sites designed to complement existing IOWATER sites. In fall 2016, PCCWQMP staff completed the first full year of assessments on 32 sites at creeks, streams and drainage ditches throughout Polk County. Since then, our program partnered with surrounding municipalities, trained 19 city employee and public volunteers to allow our program to grow to 58 actively monitored sites.

Establishing a program to assess the health of the watersheds and create a better understanding of the needs of our watershed system within Polk County is not without challenges. The Iowa Nutrient Reduction Strategy (INRS) was developed with the goal of reducing nutrient loads, which end up in the Mississippi River and ultimately in the Gulf of Mexico, by 45%. The strategy specifically looks at phosphate and nitrogen levels, nutrients that lead to algae growth. These are the leading cause of hypoxia, low dissolved oxygen which cannot support aquatic life, in the Gulf of Mexico. Several challenges identified in the INRS report are consistent with challenges the PCCWQMP faces. Such challenges include:

1. How much data is necessary to accurately establish a baseline for determining the stream health and assess the health of the watersheds? The Nutrient Water-Quality Monitoring Framework suggests that 10-20 years of consistent monitoring in small stream sites consistently is critical. Operating a monitoring program long term comes with several challenges. However long-term monitoring is necessary to develop a baseline trend as weather and streamflow vary from year to year.
2. What parameters determine if target areas are in need of water quality improvement? Where do the nutrients come from or how to identify the origin of nutrients? What are the relative contributions of nutrients from recent human activity versus nutrients already present in soil and sediment (legacy nutrients)?
3. Which management practices are most effective? How long before the management practices implemented have an impact on water quality?

This report summarizes chemical and physical data collected by PCCWQMP staff, partners and volunteers for stream sites from mid-September 2016 through mid-September 2017.

PCCWQMP field monitors, following IOWATER procedures, complete chemical and physical assessments at their sites twice a month, year round, as weather and site condition safety allow. Field monitors complete assessments on the first and third weeks of each month. The original 32 sites were monitored for the entire reporting period. The additional 26 sites added in summer 2017 were monitored as they were assigned on the same schedule. Road construction limited data collection on one of the sites during most of the year. Late summer high temperatures and lack of rain resulted in dry creek beds at eleven sites. Iced over conditions prevented assessments to be completed in late December and early January as well as a mid-January ice storm that prevented safe access to some sites. This resulted in a total of 825 site visits completed for the 58 sites. Site data is available on the EPA Water Quality Exchange (WQX) website (https://www.epa.gov/waterdata/water-quality-data-wqx) and is summarized annually.

The chemical/physical assessment includes recording air temperature, water temperature, nitrite, nitrate, pH, chloride, dissolved oxygen, phosphate, transparency, water color, water odor, stream width and depth. Water odor was recorded 92% of the time as "none." The presence of water odor may be indicative of problems with water quality. None of the assessments reported the presence of petroleum or chemical odors which may indicate a serious pollution problem. Water color can indicate the presence of sediment or algae in water. As sediment or algae accumulate in water, transparency drops. This is measured with a transparency tube. "Clear" water color correlates with a high transparency reading, generally between 51 and 60 centimeters. Fifty-nine percent of the transparency results were 51 centimeters or greater. Higher transparency results tended to occur during late fall months when cooler temperatures and lower rainfall, and consequently less runoff, occurred. Transparency was variable throughout the rest of the year. The lowest median level occurred after a significant ice storm in January 2017. Lowest transparency levels coincided with rain events and resultant high stream flows that would displace sediment from exposed stream banks and with an increased algal growth in warm summer water.

Figure 1. Ice Dam on Mud Creek in January 2017

Water temperature increases more rapidly in streams with little vegetation cover, shallow depths, and heavy sediment loads. Increasing water temperatures during the summer causes a drop in dissolved oxygen concentrations. Dissolved oxygen (DO) concentrations of less than 5 milligrams per liter (mg/L), low enough to negatively affect aquatic life, occurred on 10% of assessments. As expected, these occurred most frequently in summer and fall when stream flow was lowest and water temperatures are highest. Sites on drainage ditches 4 and 38, the Bluff Creek site and one Yeader Creek site reported low DO concentrations more frequently throughout the year.

Site averages for chloride concentrations were less than 100 mg/L for all but five sites. High concentrations of chloride, those higher than 100 mg/L, often corresponded to winter and spring runoff containing road salt as water flow is generally low and point source inputs would be most apparent. High chloride levels in late summer through early fall were noted at most sites due to high temperatures and

low rainfall. Camp and Yeader Creeks had the highest occurrence of chloride concentrations over 100 mg/L. Average chloride concentrations for the four Yeader Creek sites range from 119.00 to 135.37 mg/L. Camp Creek reported average chloride concentrations below 40 mg/L until mid-July 2017 when concentrations ranged from 154-280 mg/L. This indicates that there are likely additional sources of chloride salts from human or animal waste not detected under normal stream flow.

Because of the drought conditions experienced in late summer and early fall 2017, average phosphate concentrations of PCCWQMP sites were at or below threshold of 0.6 mg/L 81% of the time, a drop from 98% reported the previous year.

Most nitrite and nitrate concentrations, over 97% of the samples, were within the normal ranges. Nitrite in water is rare because it is quickly converted to nitrate, therefore it is not surprising that concentrations were typically zero. A result of less than 0.3 mg/L is considered normal. Nitrate is therefore more commonly found in Iowa waterways than nitrite. Nitrate concentrations equal to or greater than 20 mg/L, the IOWATER suggested threshold, can result in health issues if water is consumed. Drinking water standard is 10 mg/L. Of the PCCWQMP sites, 13 or 22%, reported readings 20 mg/L at least once. Only three of the sites had an average nitrate concentration over the drinking water standard.

In general, streams in Polk County, while not meeting drinking water standards, are safe for recreational purposes. Nitrate levels in rural streams are often well over historic concentrations, which were, less than 3 mg/L and continue to exceed drinking standards. High chloride concentrations may indicate the presence of human or animal waste and warrant further testing to determine if the level of bacteria present a health concern.

Parameters Monitored

Polk County Conservation Water Quality field monitors completed 825 assessments on 58 sites. The 2016-17 reporting period began with 32 sites. Three sites were added in May 2017; 23 were added in June and July. Sites were sampled twice a month with the exception of December 2016 when all sites but one were iced over. One site was closed most of the reporting period due to bridge construction.

Each chemical and physical sampling assessment included: weather, water clarity, color, odor, water and air temperature, precipitation over last 24 hours, stream width and maximum depth, transparency, pH, nitrate, nitrite, dissolved oxygen, chloride and phosphate.

Figure 2. IOWATER Testing Supplies

In addition to the chemical/physical assessments, habitat and biological assessments were completed in summer 2017 for each actively monitored site. Habitat assessments document changes in the streamside landscape over time. Biological assessments were completed for each monitored site in late July or early August. This assessment involves collecting and identifying benthic macroinvertebrates, aquatic insects and other small invertebrates, which can be indicative of the health of the stream. The majority of benthic macroinvertebrates found in PCCWQMP sites were of middle quality (56%) groups.


Figure 3. Extern Marc Pedersen Assessing Water Depth

Physical Parameters

Water Odor

Water odor can indicate potential problems in a stream. Field monitors record one or more of the following: none, chemical, fishy, petroleum, sewage or other. Sewage and manure odors in the air are not uncommon in Iowa, but it is uncommon for Iowa waterways to have an odor. A rotten egg smell indicates the presence of hydrogen sulfide gas. Hydrogen sulfide is a by–product of anaerobic decomposition, a natural process of plant decay and typical in areas with large amounts of organic matter and low dissolved oxygen. Petroleum or chemical smells can indicate industry or storm sewer runoff and may signal a serious pollution problem. Musky odors are generally described as a natural and slight organic odor and may be a product of organic waste or sewage contamination. Over 99% of the assessments reported no odor. The five times that a musky odor was reported it was attributed to natural decay processes.

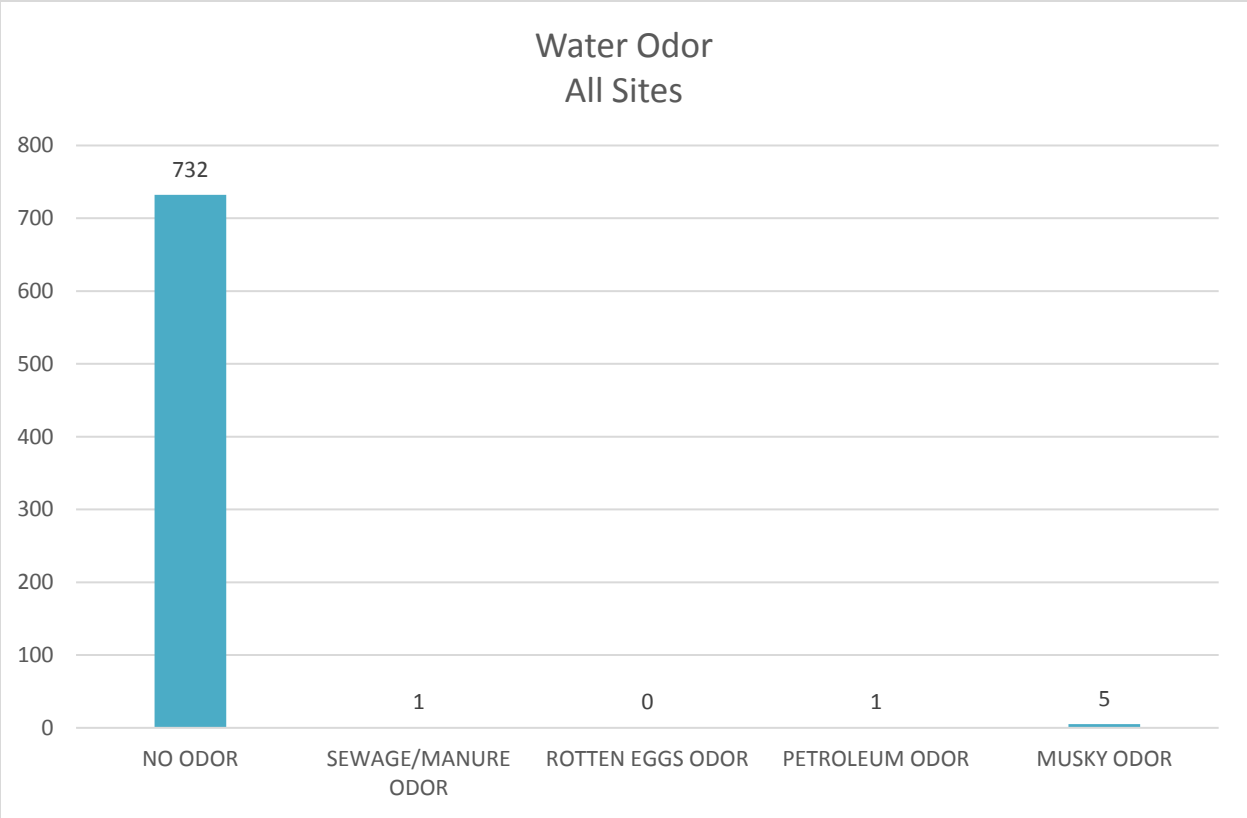

Figure 4. Water Odor Results for All Sites from Mid-September 2016 through Mid-September 2017

Water Color

Similar to water odor, the color of water can indicate potential water quality problems. Field monitors were asked to select one or more of the following water color descriptors: clear, brown, green, oily sheen, reddish, blackish, milky, and/or gray. Clear water does not guarantee clean water but indicates a low level of dissolved and suspended particulates. Brown water is usually due to presence of sediment. Green water usually indicates the presence of algae. An oily sheen may be present as a by-product of decomposition or may be due to chemical pollution. Rust or orange substances, often accompanied with an oil-like sheen, are due to natural occurring bacteria. Reddish or orange colored water indicates the presence of iron oxides. Blackish water occurs with leaf decomposition. These leaf pigments then may also cause the water to become murky. Milky water is caused by salts in the water. Gray water can be caused by both natural and human-made activities.

Figure 5. Milky-Green Water at Drainage Ditch 38 on June 6, 2017

Figure 6. Naturally occurring bacteria at Walnut Creek Site 977197

Figure 7. Oily sheen found at Drainage Ditch 38 Site 977311

Polk County Conservation monitoring site samples reported water color as “clear” 62% of the time. It is common for the water clarity to drop after precipitation events as runoff picks up soil from exposed soil along banks and surrounding area. Nearly one third of results were reported as “brown” or “clear and

brown." Less than 4% of assessments reported water color as "green." Occurrences of oily, reddish, or blackish water were rare and primarily attributed to decaying vegetative material. Less than 6% of assessments reported milky or gray water (Fig. 8).

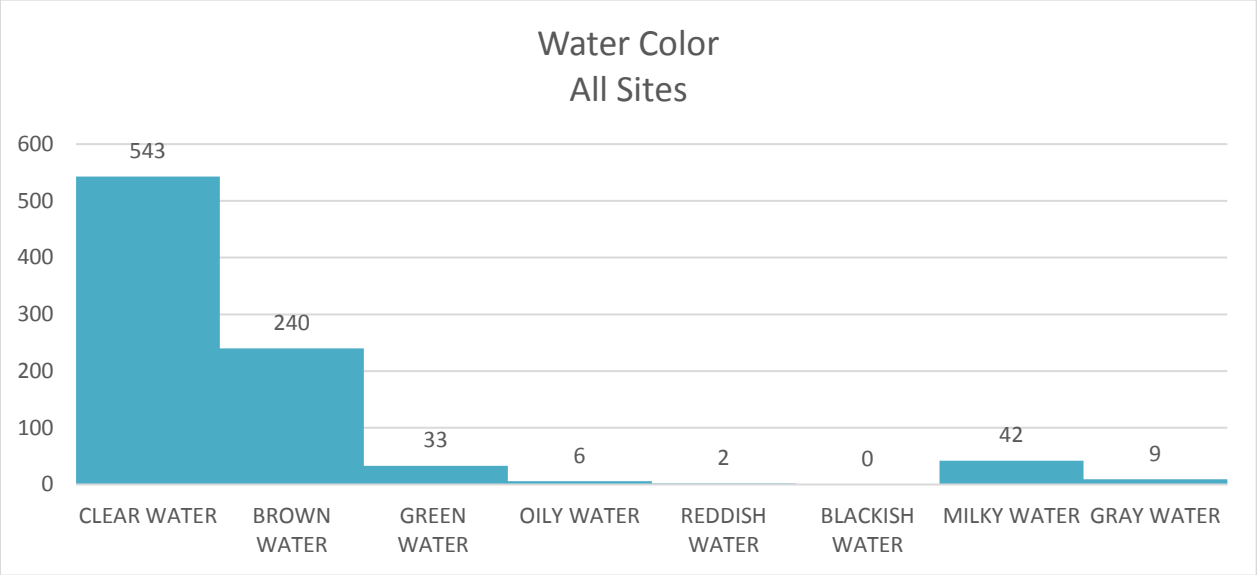

Figure 8. Water Color Results for All Sites During Mid-September 2016 – Mid-September 2017

Transparency

Transparency is a measure of water clarity. The more suspended material such as soil, algae and microbes present in the water, the less transparent the water. Transparency is measured with a transparency tube with a scale that ranges from 0 to 60 centimeters. Transparencies of 30 centimeters or greater were reported 78% of the time and 59% of the time transparency readings were greater than 50 centimeters. Lowest transparency readings occurred following a January ice storm which caused high sediment levels and from late spring through fall when long periods of sunlight and high water temperatures promote algal growth. Winter and spring assessment period median results were consistently 60 and 60+ (maximum clarity). The assessment period median dropped to 34 to 51 centimeters in late spring through early fall with few exceptions due to the combination of soil runoff and increased algal growth. The yearly average minimum for all sites was 29.89 cm (Fig. 9).

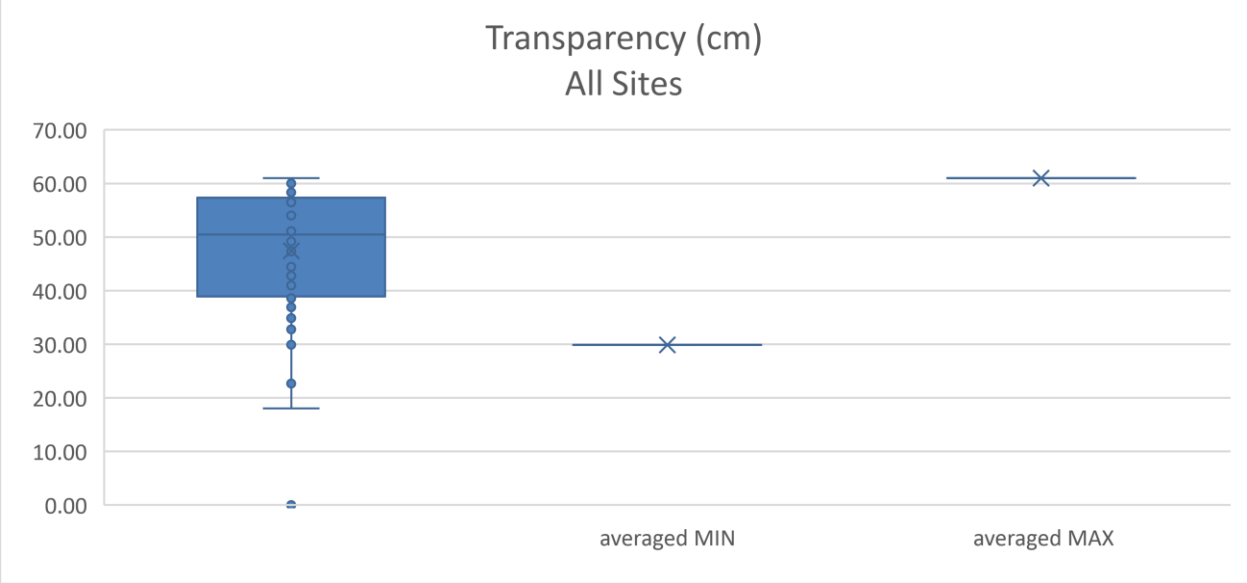

Figure 9. Transparency Readings for All Sites

Water Temperature

Water temperature directly affects many properties of a stream. Temperatures fluctuate seasonally, daily and throughout the day. High temperatures reduce the amount of dissolved oxygen water is able to hold. Temperature affects photosynthesis by algae and aquatic plants, metabolic rates of aquatic animals and organisms. Groundwater flow, weather, riparian vegetation and other factors affect stream water temperatures. Average site water temperature ranged from 32.0 to 79.61 degrees Fahrenheit (Fig. 10).

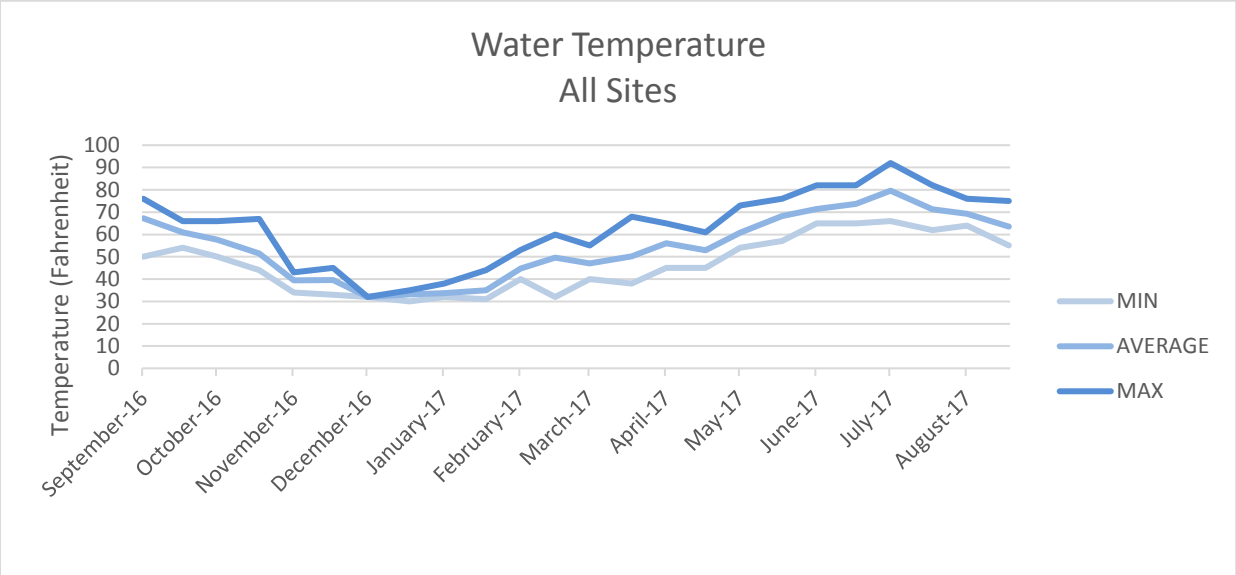

Figure 10. Range of Water Temperatures for All Sites During Mid-September 2016 – Mid-September 2017

Weather Conditions

Rain and snow events affect water color and clarity as sediment travels into the waterway. Weather conditions including rainfall within the last 24 hours were recorded during each assessment. Typically water clarity drops after rain events, chlorides rise with snowmelt and clarity improves when winter temperatures arrive. The *Iowa DNR News 2017 Water Ye*ar report of October 9, 2017, reported a statewide average of 3.28 inches less than normal precipitation while temperatures averaged 2.6 degrees above normal, making 2017 the fourth warmest year among the 144 years of records.

Chemical Parameters

Chloride

Chloride, a salt, can be the result of fertilizers, human waste or animal waste present in a water body. Sources of chloride may include livestock, septic system leakage or discharge from a municipal wastewater facility. Elevated levels in winter may be due to road salt runoff. Typical concentrations of chloride in Iowa streams range from 20 to 30 milligrams per liter (mg/L). Median chloride readings ranged from 25 to 59 mg/L for most PCCWQMP sites and were typical of Iowa streams during times of normal rainfall. However, readings rose during winter and again during the late summer drought. The number of readings over 100 mg/L rose from 28 in 2015-16 to 49 in 2016-17 (Fig. 11). In January, Yeader Creek experienced chloride concentrations that were at least 611 mg/L, the test strip maximum reading, greater than recorded levels from the 2015 – 2016 recording cycle. This occurred after a winter ice storm. Yeader Creek had above normal readings January through March and June through August 2017. North Walnut Creek recorded readings of 108 to 300 mg/L during the same winter period (Fig. 12). Other above normal readings were recorded during drought conditions in late summer and early fall on Bluff, Camp, Fourmile, Little Fourmile, Jordan, Mud, Saylor and Walnut Creeks.

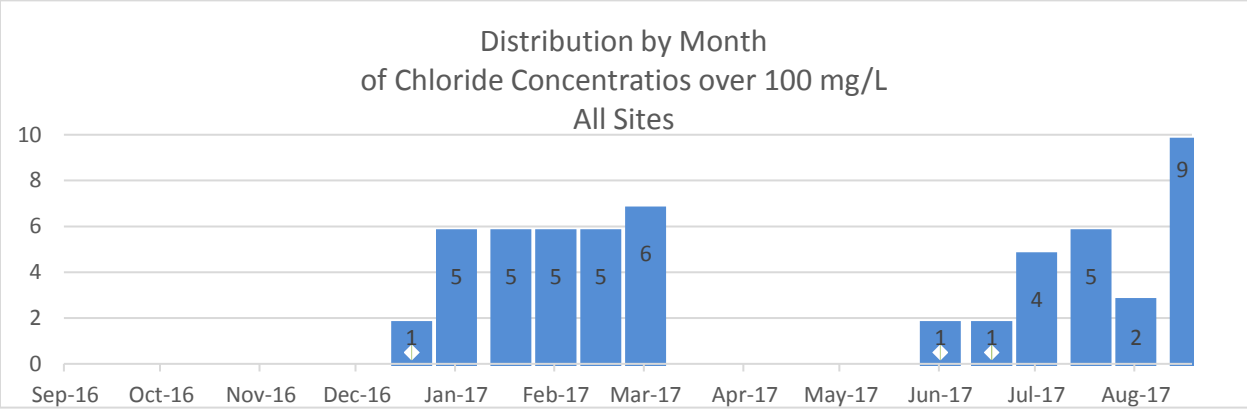

Figure 11. Frequency of Chloride Concentrations Over 100 mg/L Mid-September 2016 – Mid-September 2017

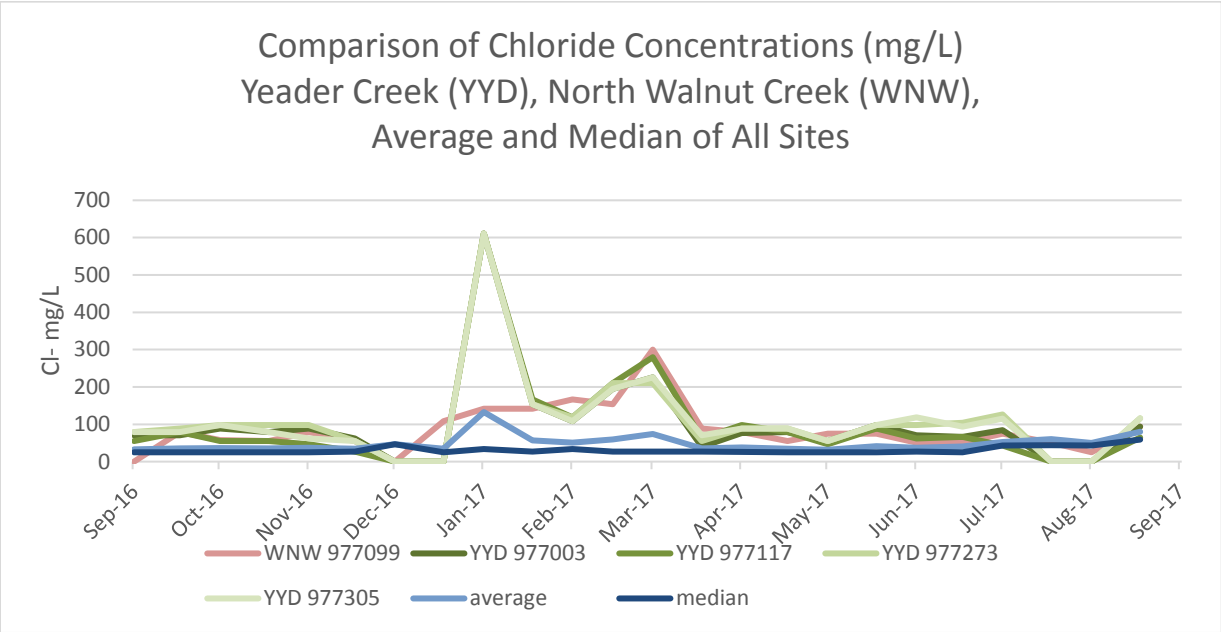

Figure 12. Comparison of Chloride Concentrations for Sites On Yeader and North Walnut Creeks to All PCCWQMP Sites During Mid-September 2016 – Mid-September 2017

Dissolved Oxygen

The amount of dissolved oxygen in water fluctuates with water temperature, stream flow and rate of photosynthesis of aquatic plants. Transparency, time of day, time of year and human activities influence these factors. Iowa's water quality standard to support aquatic life is a minimum of 5 mg/L of dissolved oxygen for warm water streams.

Median results ranged from 8-10 mg/L in fall through spring (mid-September 2016 through mid-May 2017) and 6-8 mg/L in summer (June through early September, 2017), which are above the minimum water quality standard, below which adversely affects aquatic life. Dissolved oxygen levels dropped below the minimum standard during the drought of summer 2017 on 22 sites. At this time, stream flow was lowest and water temperatures were at their highest. Three sites in northeast Polk County (Bluff Creek, Drainage Ditch 4 and Drainage Ditch 38) experienced periodic dissolved oxygen rates below the 5 mg/L standard throughout the year. Yeader Creek also reported periodic low dissolved oxygen readings (2, 3, 4, or 5) throughout fall 2016 and again in spring through fall 2017.

pH

The pH of water is a measure of its acidity and is quantified on a logarithmic scale of zero to 14. A neutral pH reading is seven. Readings less than seven are acidic. Readings below six can have a harmful impact on the health of the aquatic system. The pH level is affected by the types of soils and bedrock in the watershed and acidity of precipitation. Acidic water can allow substances such as ammonia and heavy metals to leach from soils. Basic, or water with high pH can also have a negative effect on aquatic organisms. Iowa rivers average 8.2 due to alkaline soils and limestone bedrock in many areas. The majority of PCCWQMP sites consistently had pH readings of 7, 8 or 9 (Fig. 13). A reading of 6 or less was recorded only 7% of the time. It is not uncommon to have low pH readings during winter when water temperatures are below 40 degrees Fahrenheit.

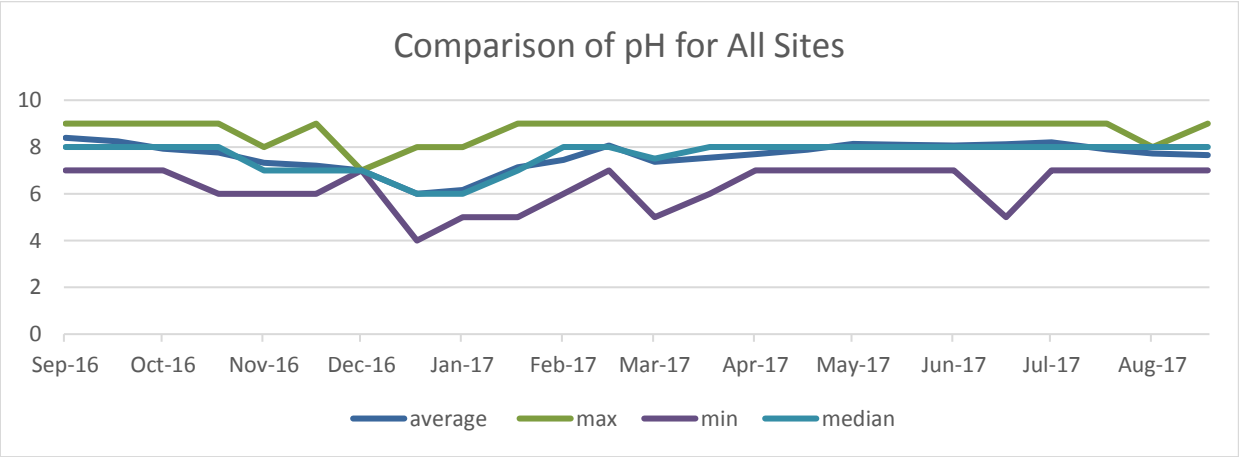

Figure 13. Comparison of pH for All Site During Mid-September 2016 Through Mid-September 2017

Nitrogen

Nitrogen in water was recorded in two forms, nitrate and nitrite. Both nitrate and nitrite are necessary nutrients for plant growth. Too much nitrogen in the water will result in increased plant growth and can change the types of plants and other organisms that live in the stream. Nitrogen in streams can come from human and animal waste, decomposing plants, leaching from soil, and fertilizers from lawns, golf courses and farmland.

Nitrite is a transitional product and therefore is rare in water as it is quickly returns back to the atmosphere as nitrogen gas or converts to nitrate. Not surprisingly, PCCWQMP sites had very few instances of detectable nitrite. Over 94% of the readings were reported as zero mg/L.

Figure 14. Nitrite/Nitrate Testing

Nitrate, however, is very soluble in water and therefore is now present at high levels in some streams, particularly those found near rural agricultural areas. Historically, nitrate concentrations were low. In the early 20th century, nitrate concentrations in the Iowa, Cedar and Des Moines Rivers increased from less than 0.06 mg/L in 1906-07 to 1.6-2.8 mg/L in 1944-1956, to 6.1- 7.2 mg/L over the last 30 years. (Iowa Geological Survey, 1955; Iowa Department of Natural Resources-Geological Survey Bureau, 2001.)

PCCWQMP sites had nitrate concentrations of 5 or 10 mg/L 180 times or 38% of the time (Fig. 15). While this concentration is at or below the drinking water quality standard for nitrate (10 mg/L), it is more than two times the concentrations found in the mid 1940's and 50's. Seventeen sites located in Beaver, Santiago, Fourmile, Deer, Mud, Rock, Saylor and Walnut Creeks reported concentrations of 20 mg/L. Most sites frequently reported readings over 10 mg/L throughout the spring and summer. Sites with high nitrates in the spring are often found in rural Polk County and may be experiencing fertilizer runoff from agricultural lands. Long-term exposure to elevated nitrate can have a detrimental impact on human health and the aquatic system.

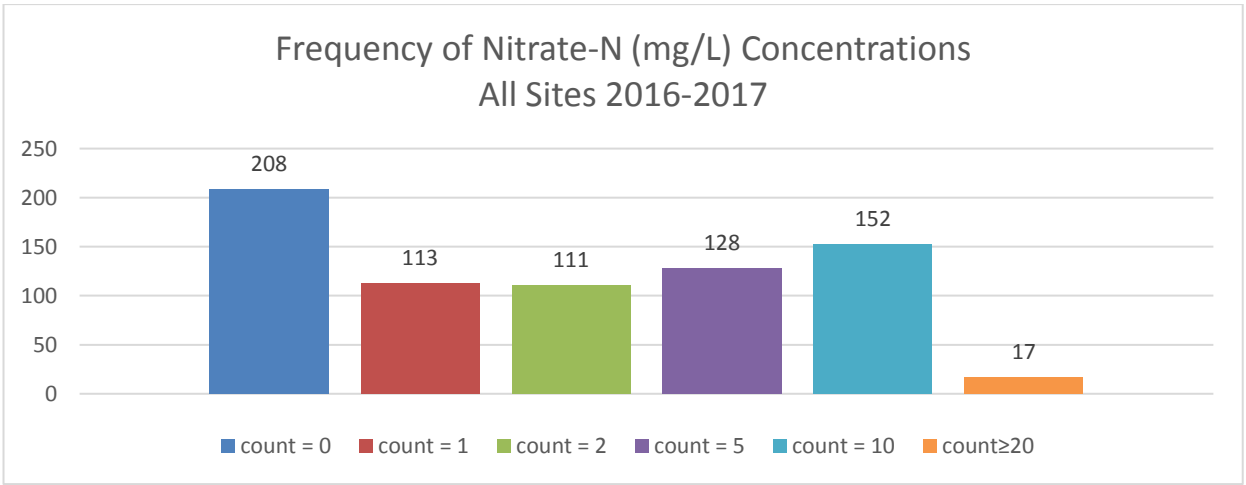

Figure 15. Frequency of Nitrate Concentrations for All Sites During Mid-September 2016 – Mid-September 2017

Phosphate

Phosphorus naturally occurs in streams attached to sediment. Dissolved orthophosphate, an essential nutrient, is generally the limiting factor for plant growth in surface water. Natural sources of phosphorus are from soil and rocks, however when elevated levels occur it is often the result of human, animal or industrial waste reaching waterways and runoff from fertilized lawns and farmland. Excess phosphorus in water results in increased plant growth and algal blooms. When these plants and algae begin to die and decompose, hypoxia (low dissolved oxygen) can result and lead to the death of plant and animal life in the stream. The water quality monitoring kit measures orthophosphate, which will be referred to as simply "phosphate."

According to the Iowa DNR, average phosphate concentrations for Iowa streams is 0.19 mg/L. PCCWQMP results in a similar range of 0-0.2 mg/L dropped from 60% of all 2015-2016 results to 46% of all 2016-2017 results (Fig. 16). PCCWQMP uses the Iowater guidelines, which considers phosphate concentrations over 0.6 mg/L abnormal.

Reported concentrations from 2015-2016 were highest during the summer. Results from 2016-17 were found to be higher than previous reporting period at sites on Beaver, Fourmile, Paw, Spring, Mud, Walnut and Yeader Creeks sites. Camp Creek reported elevated average phosphate concentrations in both summer and fall 2017.

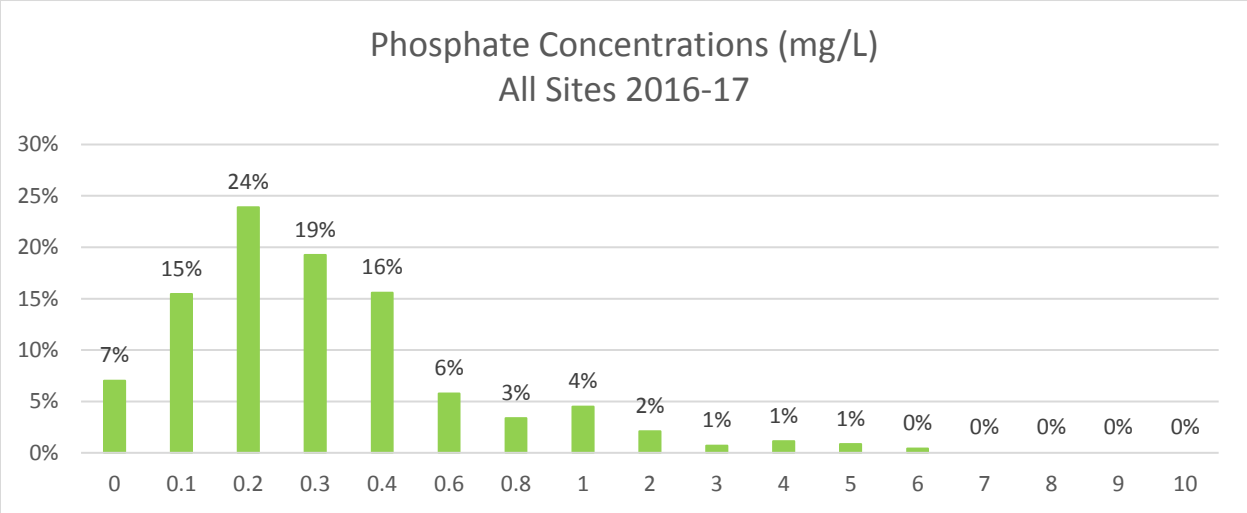

Figure 16. Phosphate Concentrations for All Sites During Mid-September 2016 – Mid-September 2017

Benthic Macroinvertebrates

Benthic macroinvertebrates (BMI) which are sensitive to pollution, are a good water quality indicator. Those which are "pollution intolerant" (BMI high-quality group) indicate a healthy stream with good water quality. Those organisms which are "somewhat tolerant" to pollution (BMI middle-quality group) are able to survive some water quality degradation but are unable to tolerate very poor conditions which the BMI low-quality group can, due to special adaptations. Biological assessments were conducted in late July or early August. Many sites reported low numbers of organisms.

Macroinvertebrates of the BMI low-quality group represent only 30% of the total macroinvertebrate species found (Fig. 17). Following the IOWATER Biological Assessment manual procedure, a simplified Index of Biotic Integrity (IBI) was calculated for each water monitoring site. The High-Quality (HQ) benthic macroinvertebrates were given a tolerance score of 3, the Middle-Quality (MQ) a score of 2 and the Low-Quality (LQ) a score of 1. To provide a method of comparison, a metric is calculated for each site using the following calculation:

$$IBI = \frac{(\#HQ \times 3) + (\#MQ \times 2) + (\#LQ \times 1)}{\#HQ + \#MQ + \#LQ}$$

Sites with an IBI less than 1.75 are considered to have poor benthic macroinvertebrate community. Sites ranging between 1.76 – 2.25 would indicate fair benthic macroinvertebrate population and sites with scores greater than 2.25 would indicate the site is dominated by benthic macroinvertebrates in the high-quality group.

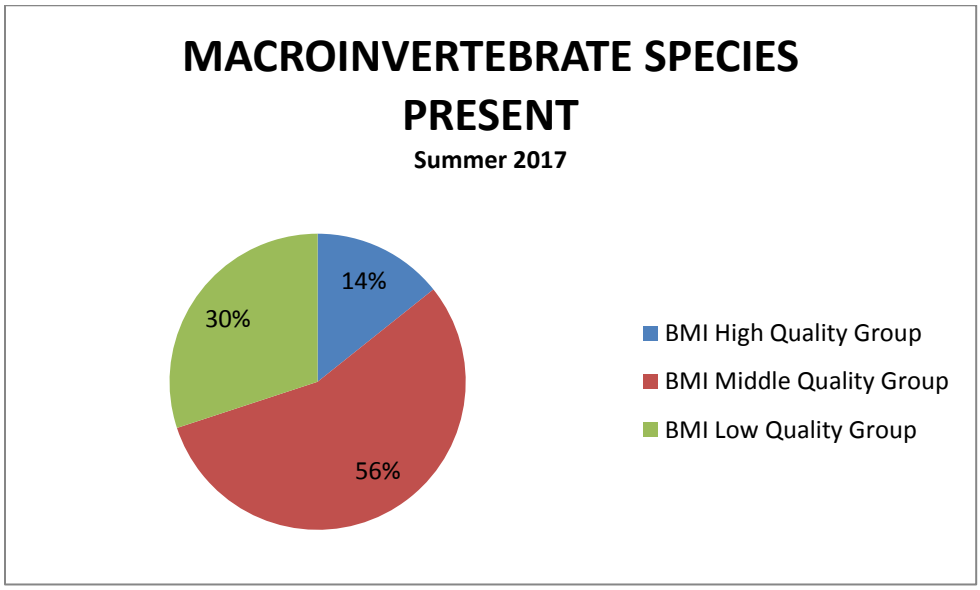

Figure 17. Summer 2017 Biological Assessment Results

Analysis Results

Beaver Creek Watershed

Site Number	Creek Name	Site Name
BBV 925036	Beaver Creek	Beaver Creek Snapshot (Site 18 - Beaver Creek)
BBV 977120	Beaver Creek	Beaver Creek Snapshot (Site 19 - Beaver Creek)
BBV 977160	Beaver Creek	Polk County Snapshot (Site Beaver Creek at Prairie Point)
BLB 977121	Little Beaver Creek	Beaver Creek Snapshot (Site 20 - Little Beaver Creek)

Table 1. Beaver Creek Water Quality Monitoring Sites

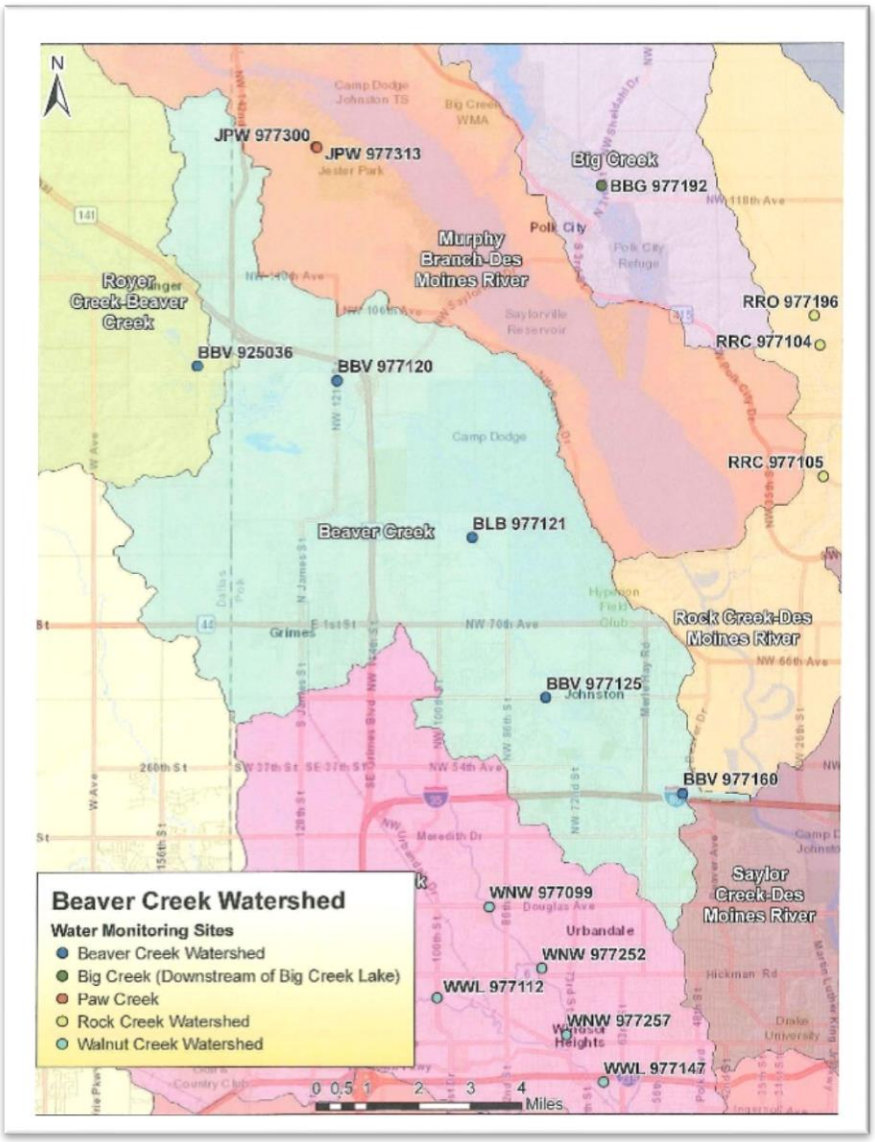

Figure 18. Beaver Creek Water Quality Monitoring Sites

The Beaver Creek watershed encompasses 244,347 acres and is dominated by agriculture with only a small fraction of urban acreage. Four sites in Beaver Creek watershed were identified for monitoring (Fig. 18) and one new site on Little Beaver Creek was added in the summer of 2017.

The furthest upstream, site 925036 (Fig. 19), is just south of Granger in Dallas County. The site furthest downstream, site 977160 (Fig. 20), is located just north of I-80 near the Trestle to Trestle Trail. Site 977121, located on Little Beaver Creek, is near Crosshaven Park in Johnston.

Figure 19. Beaver Creek Site 925036

Chloride concentration readings were within normal all year long at all Beaver Creek sites (Fig. 24). The Little Beaver Creek site had high chloride concentrations in late summer. Abnormal pH phosphate, nitrate and dissolved oxygen concentrations were reported. All sites reported high nitrates in fall 2016, spring and early summer 2017 (Fig. 21). The Little Beaver Creek Site 977121 reported high nitrates in the late summer and fall 2017. Dissolved oxygen concentrations fell in summer and early fall when water levels were lowest and water temperatures were highest (Fig. 23).

Benthic macroinvertebrates in the high- or middle-quality groups were present at sites 925036 and 977160. No macroinvertebrates were collected on site 977120 due to low water. Monitoring on site 977121 began after the Biological Assessment monitoring period. Site 925036 had an IBI of 2.33 indicating good benthic macroinvertebrate health. The IBI for site 977160 fell in the fair benthic macroinvertebrate population range.

Figure 20. Beaver Creek Site 977160

Elevated nitrate concentrations were reported spring through early summer (Fig. 21). Maximum nitrate levels reached 20 mg/L at sites 925036, 977121 and 977160, well over the Iowa stream nitrate average of 5.8 mg/L and above the drinking water standard of 10 mg/L (Fig. 21). These levels, a health risk for drinking water, are not considered a safety concern for in stream recreational activities such as

canoeing, kayaking, fishing, etc.

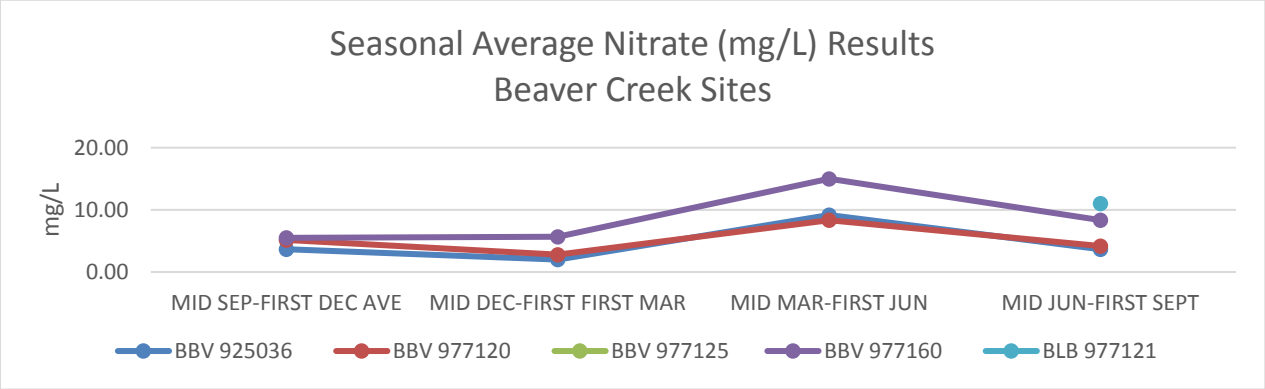

Figure 21. Seasonal Average Nitrate Concentrations for Beaver Creek mid-September 2016 through mid-September 2017

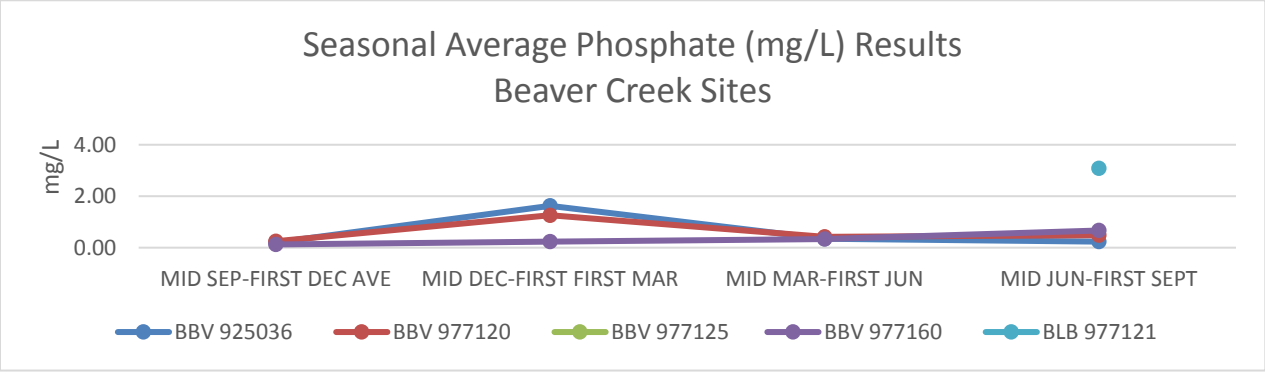

Figure 22. Seasonal Average Phosphate Concentrations for Beaver Creek mid-September 2016 through mid-September 2017

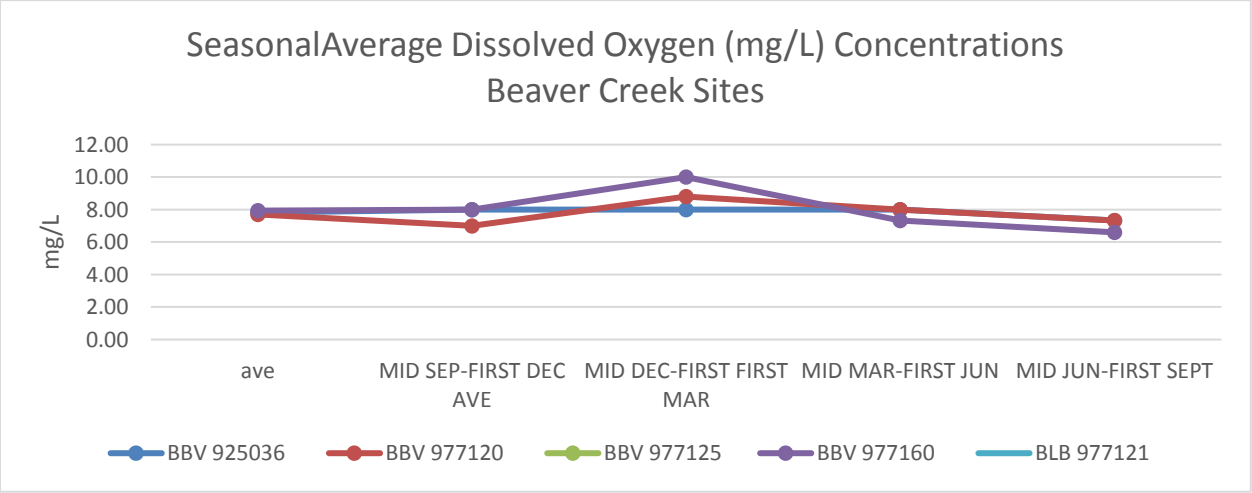

Figure 23. Seasonal Average Dissolved Oxygen Concentrations for Beaver Creek Mid-September 2016 Through Mid-September 2017

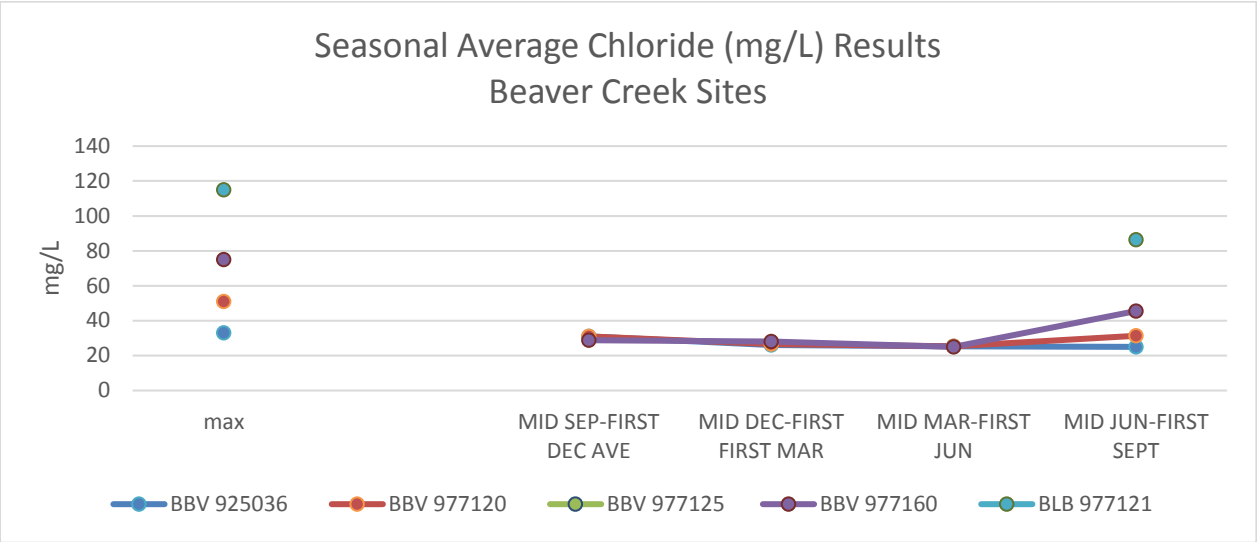

Figure 24. Seasonal Average Chloride Concentrations for Beaver Creek Mid-September 2016 Through Mid-September 2017

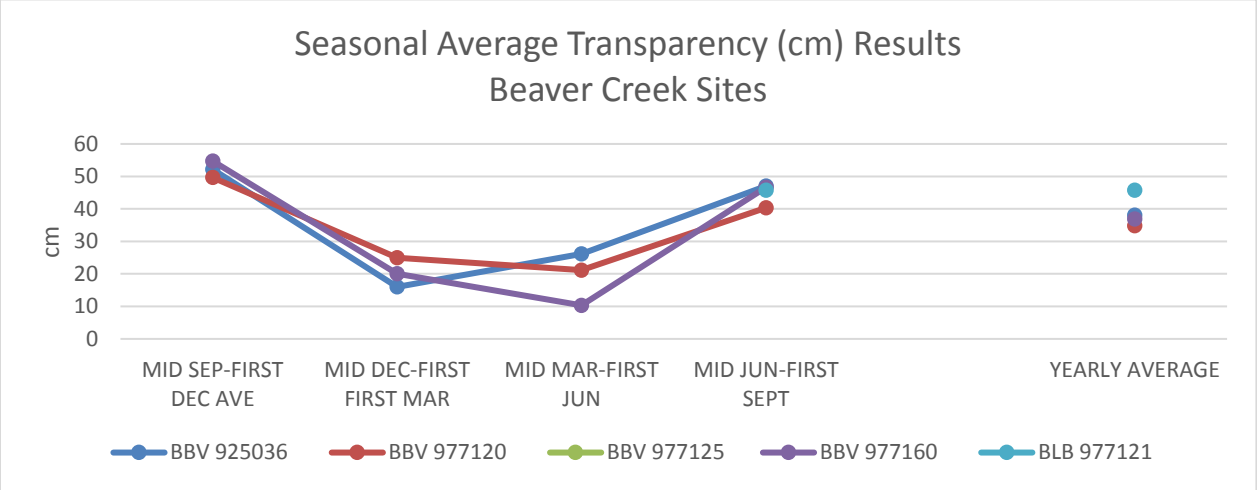

Figure 25. Seasonal Average Transparency Results for Beaver Creek Mid-September 2016 Through Mid-September 2017

Big Creek (Downstream of Big Creek Lake)

Site Number	Creek Name	Site Name
BBG 977192	Big Creek	Big Creek – Through Polk City Park/Refuge

Table 2. Big Creek Water Quality Monitoring Sites

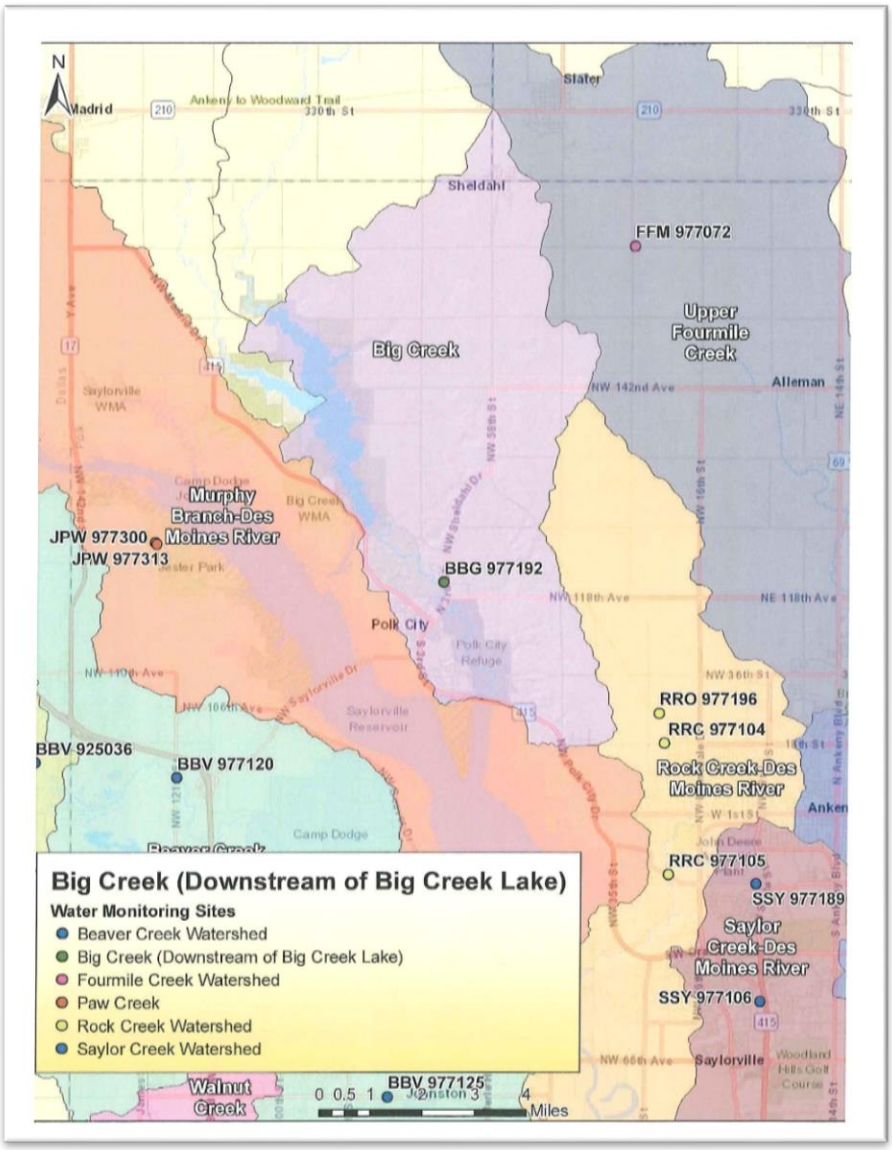

Figure 26. Big Creek Water Quality Monitoring Site

Big Creek Site 977192 (Fig. 26) is located on Big Creek near All Sesaons Park in Polk City, Iowa. This creek, in part, is also referred to as Wolf Creek. The creek leaves Big Creek Lake, flows through and along the Tournamenet Club of Iowa golf course until reaching the water monitoring site. The creek flows along the park terminating at the Saylorville Wildlife Refuge.

Monitoring on this site began on May 5, 2017. Nine assessments were completed during the 2016-17 season. The yearly average transparency was 29.89 cm (Fig. 32) which is lower than most sites (bottom 10% of all results) and consistenly lower than the median result during each assessment period. All other chemical/physical assessment results reported during this time are within normal range.

A biological assessment for this site was completed by indicating the present or absence of benthic macroinvertebrates. Because the number of macroinvertebrates found were not recorded, the IBI was not calculated.

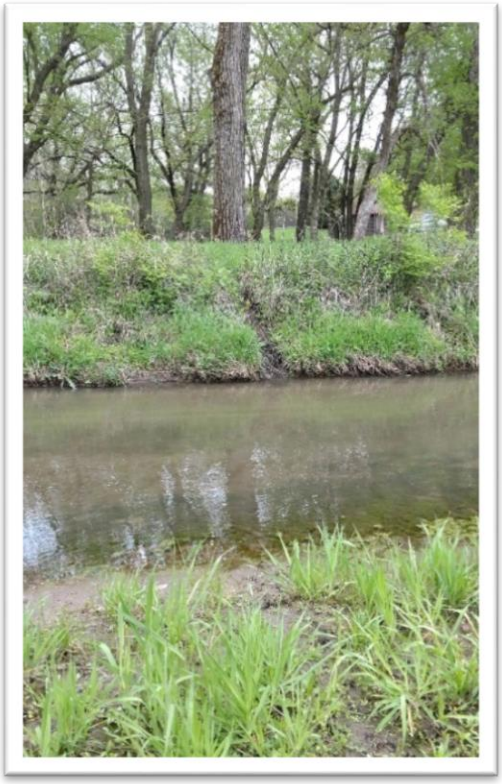

Figure 27. Big Creek Site 977192

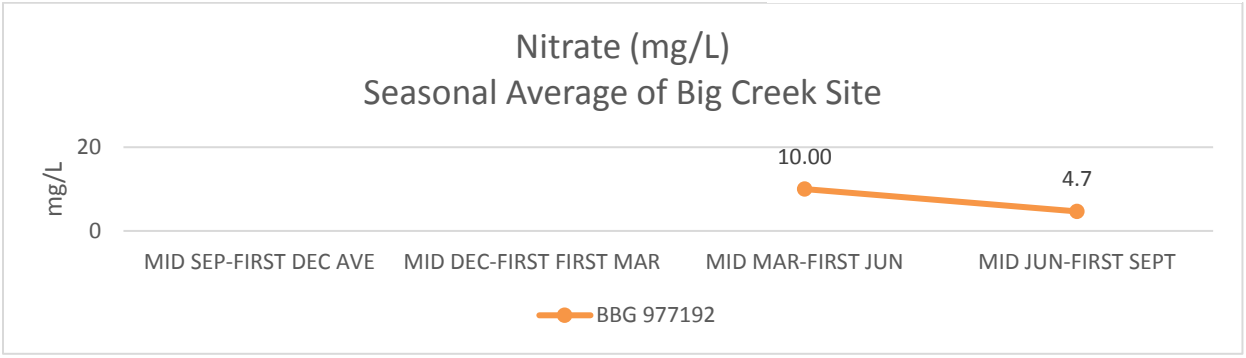

Figure 28. Seasonal Average Nitrate Concentrations for Big Creek Site Mid-September 2016 Through Mid-September 2017

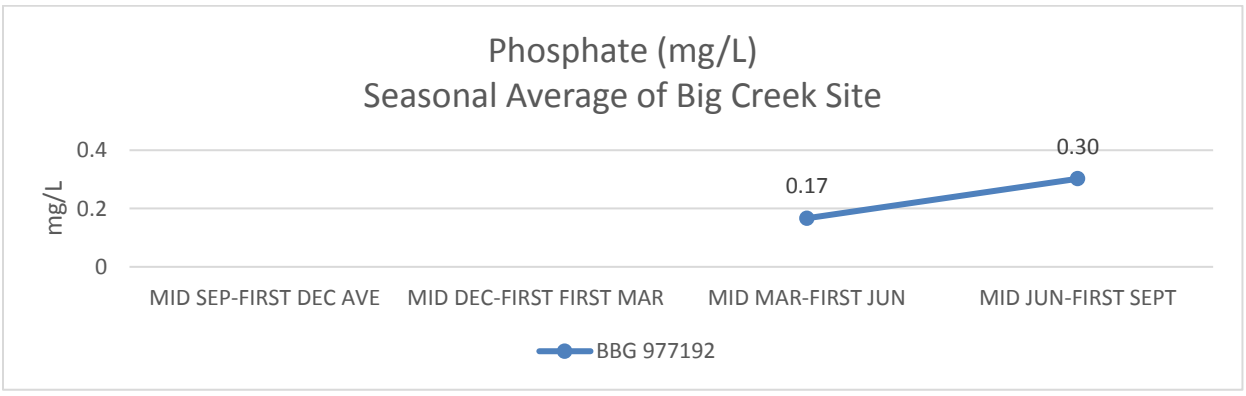

Figure 29. Seasonal Average Phosphate Concentrations for Big Creek Site Mid-September 2016 Through Mid-September 2017

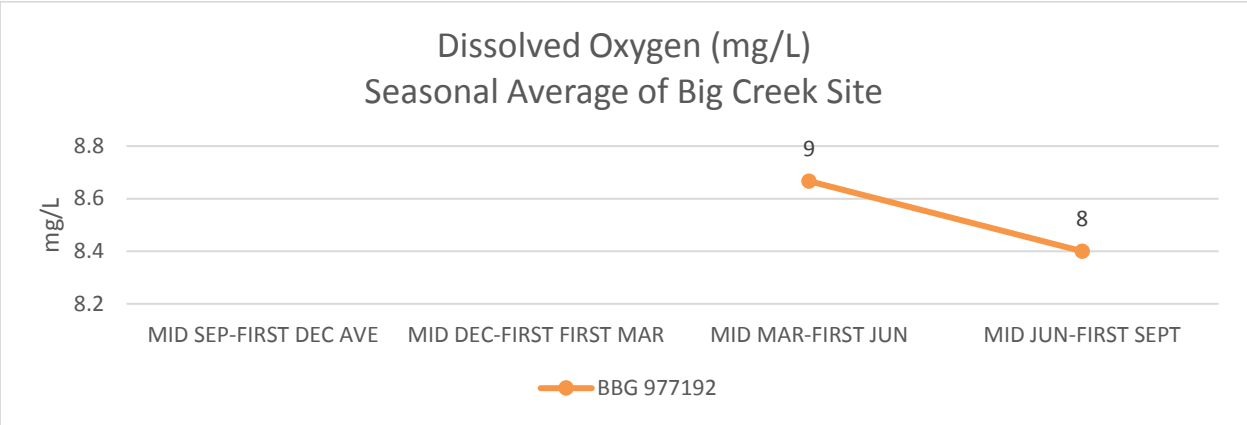

Figure 30. Seasonal Average Dissolved Oxygen Concentrations for Big Creek Site Mid-September 2016 Through Mid-September 2017

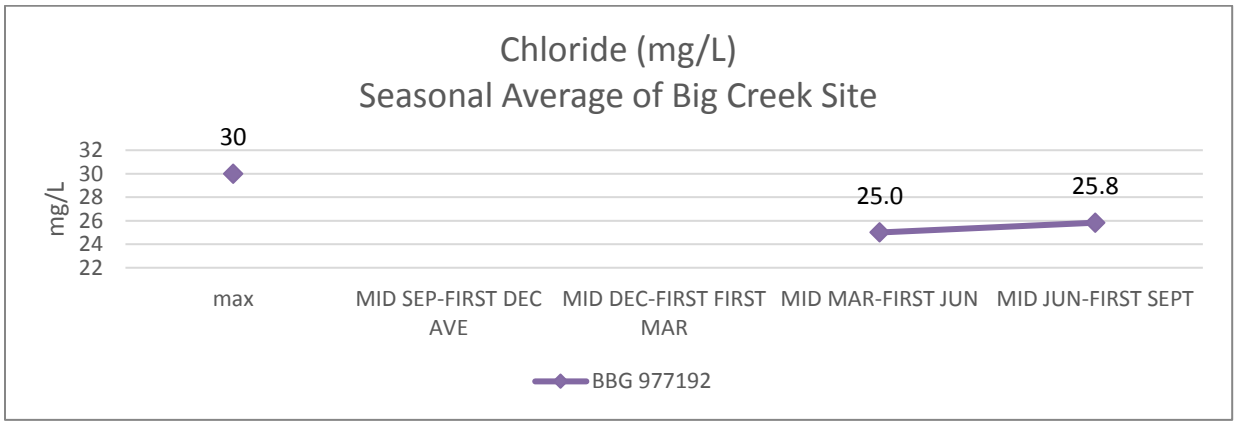

Figure 31. Seasonal Average Chloride Concentrations for Big Creek Site Mid-September 2016 Through Mid-September 2017

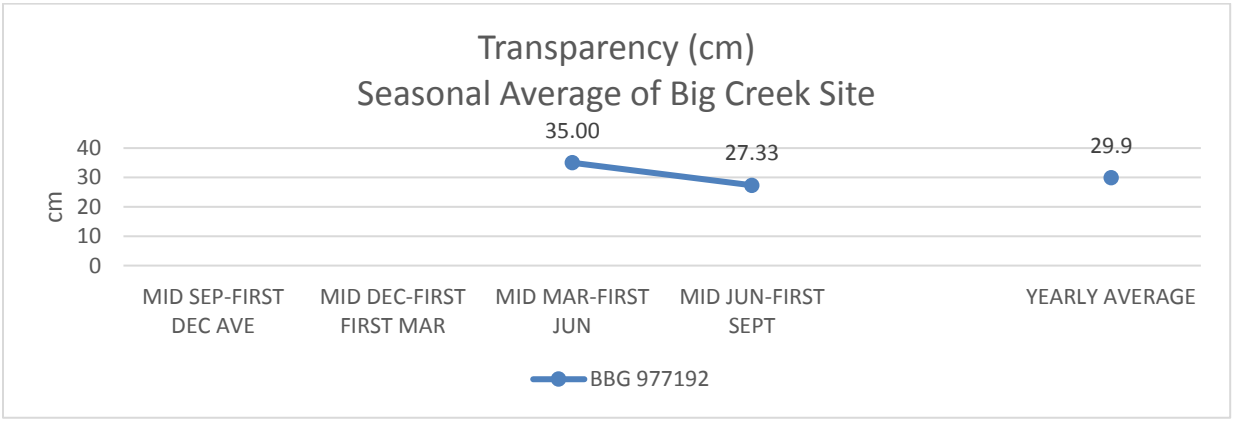

Figure 32. Seasonal Average Transparency for Big Creek Site Mid-September 2016 Through Mid-September 2017

Mud, Camp and Spring Creeks Watersheds

Site Number	Creek Name	Site Name
CCM 977152	Camp Creek	Camp Creek/Thomas Mitchell Park
CCM 977066	Camp Creek	Polk County Snapshot (Site CC1 - Camp Creek)
CCM 977067	Camp Creek	Polk County Snapshot (Site CC2 - Camp Creek)
MMD 977303	Mud Creek	Mud Creek - NE 62nd
MMD 977304	Mud Creek	Mud Creek - NE 12th Av
MMD 977302	Mud Creek	Mud Creek NW of Runnells
SSP 977242	Spring Creek	Spring Creek (PH Site 6)
SSP 977108	Spring Creek	Polk County Snapshot (Site SC2 - Spring Creek)

Table 3. Mud, Camp and Spring Creeks Water Quality Monitoring Sites

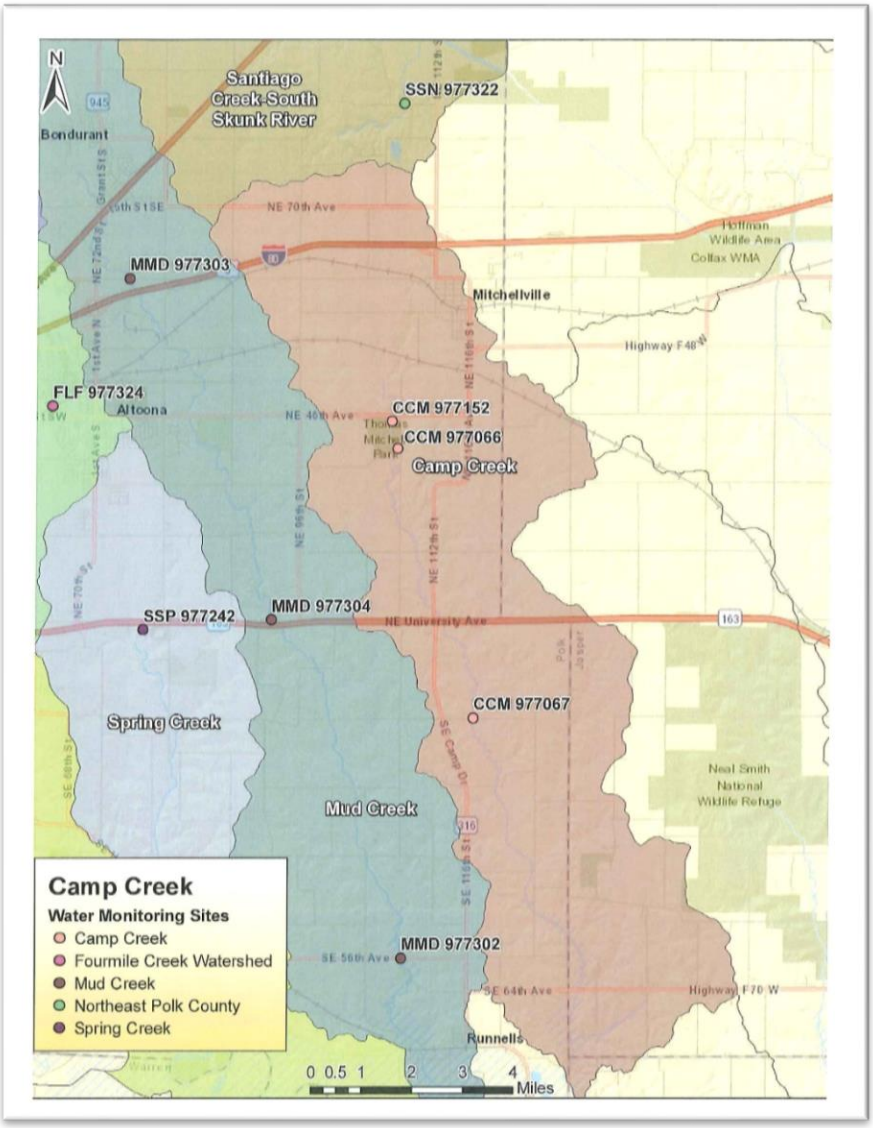

Figure 33. Camp Creek Water Monitoring Sites

The Mud, Camp and Spring Creeks Watersheds cover over 64,511 acres. Although primarily rural land, communities in this area include rapidly urbanizing areas of Pleasant Hill, Altoona and Bondurant.

All but one site reported at least one higher than normal phosphate reading. These readings occurred in January and again in late summer 2017 (Fig. 38). Half of the sites reported lower than normal pH readings in winter. One Mud Creek site and all Camp Creek sites experienced very high chloride levels during the late summer; however, Spring Creek concentrations remained normal during this time (Fig. 41).

Camp Creek

Three sites in Camp Creek were monitored. Sites 977152 and 977066 are located within Thomas Mitchell Park and site 977067 is located in the far southeast corner of the county near the Metro Waste Authority Environmental Learning Center (Fig. 33).

Dissolved oxygen concentrations remained within normal ranges throughout the year (Fig. 40). Above normal phosphate, concentrations were found much of the year at all three sites (Fig. 38). High phosphate concentrations of 4 mg/L and 6 mg/L were reported every season except spring 2017.

Figure 34. Camp Creek Site 977152

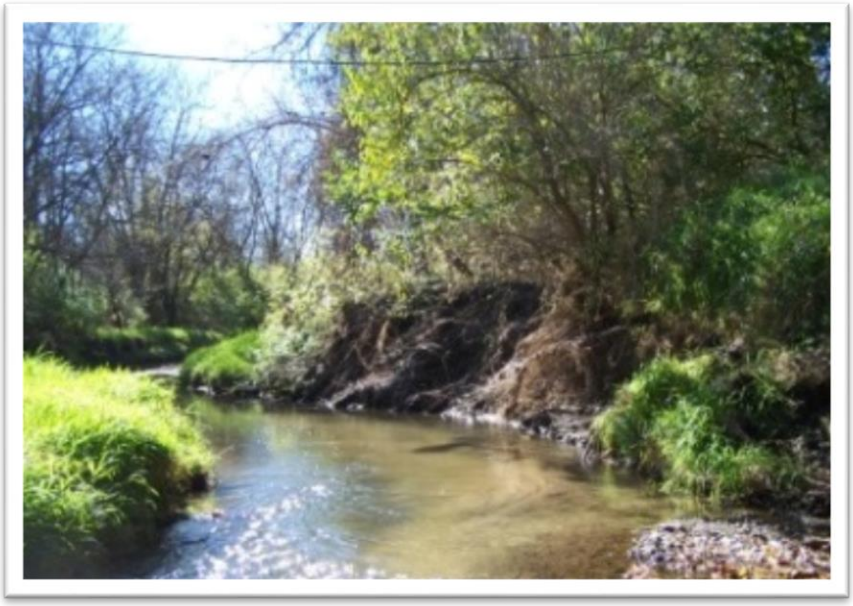

Figure 35. Camp Creek Site 977066

Nitrate concentrations remained below the IOWATER threshold of 20 mg/L for all but one sample; however, results were reported at the drinking water standard of 10 mg/L half of the time (Fig. 37).

Phosphate and chloride concentrations significantly increased as summer 2017 progressed (Figs.38 & 41). This coincided with a late summer drought causing low or no water flow. These rates are likely due to runoff from nearby agricultural land.

All categories of Benthic Macroinvertebrates (BMI) were found in small numbers at site 977152. The Biological Assessment at site 977066 and 977067 found only organisms in the BMI high- and middle-quality groups. An IBI of 1.89 for site 977152 and 2.22 for site 977066 fell in the fair benthic macroinvertebrates range. An IBI of 2.29 for Site

Figure 36. Camp Creek Site 977067

977067 fell in the good benthic macroinvertebrate population range.

The drop in water quality due to dramatic increase of the phosphate concentrations and chloride concentrations was likely due to a late summer drought. The resulting higher than normal concentrations are of concern for aquatic life (Figs. 38 & 40). During normal flow, the creek is considered safe for recreational activities such as kayaking, fishing and wading.

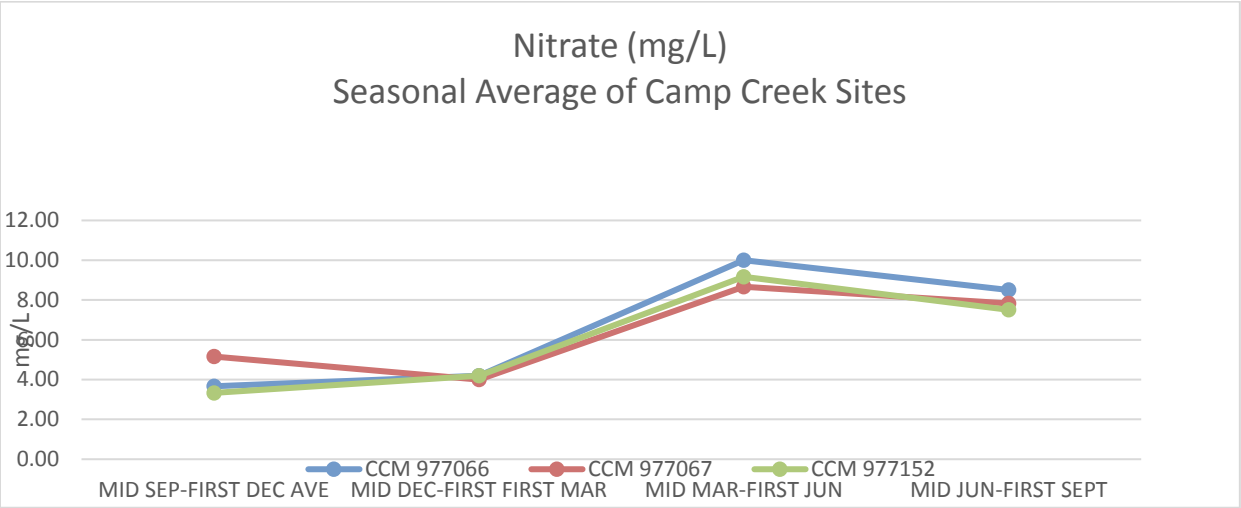

Figure 37. Nitrate Concentrations for Camp Creek Mid-September 2016 Through Mid-September 2017

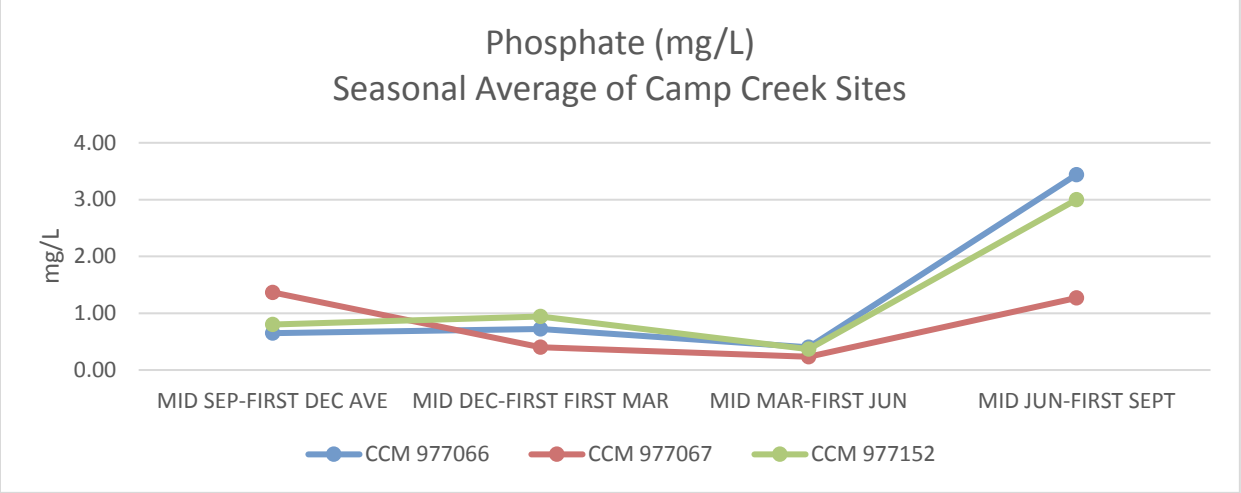

Figure 38. Seasonal Average Nitrate Concentrations for Camp Creek Mid-September 2016 Through Mid-September 2017

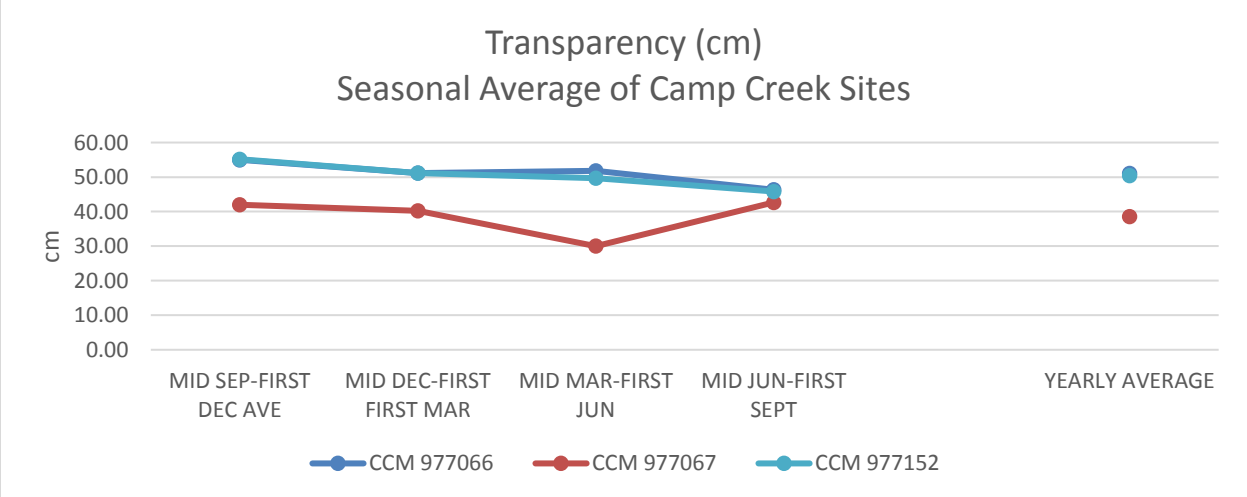

Figure 39. Seasonal Average Transparency for Camp Creek Mid-September 2016 Through Mid-September 2017

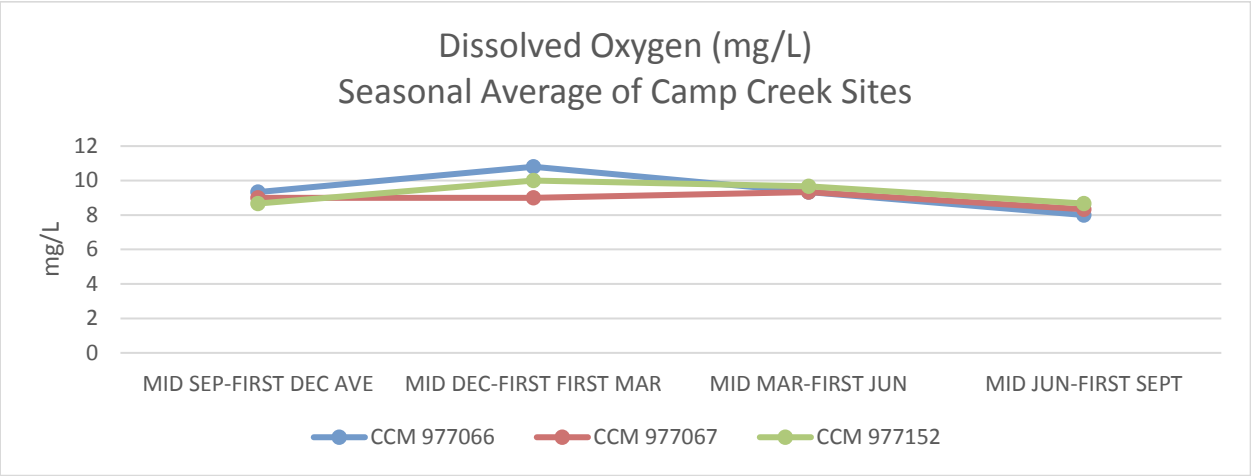

Figure 40. Seasonal Average Dissolved Oxygen Concentrations for Camp Creek Mid-September 2016 Through Mid-September 2017

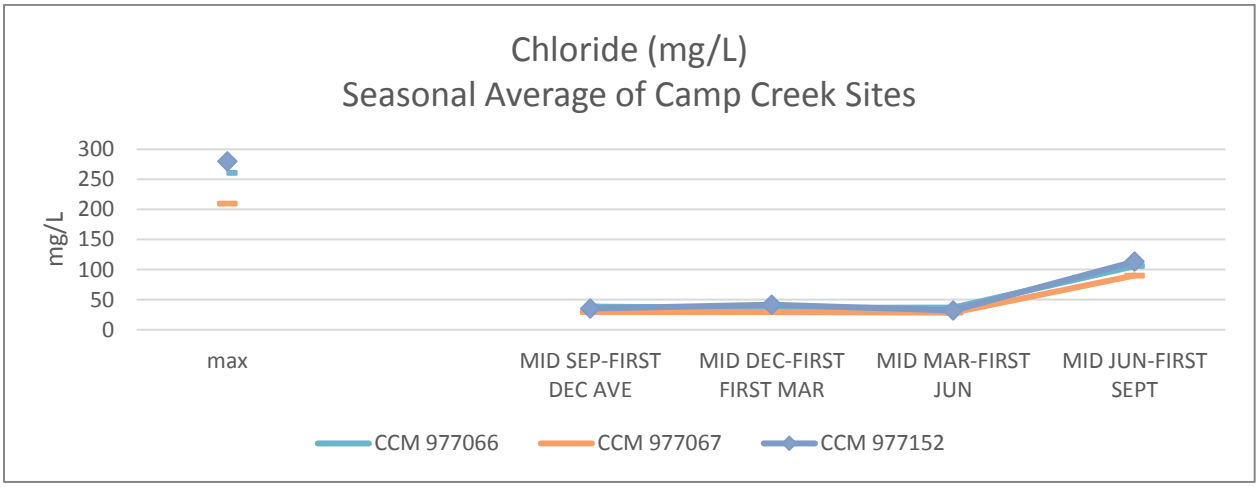

Figure 41. Seasonal Average Chloride Concentrations for Camp Creek Mid-September 2016 Through Mid-September 2017

Mud Creek

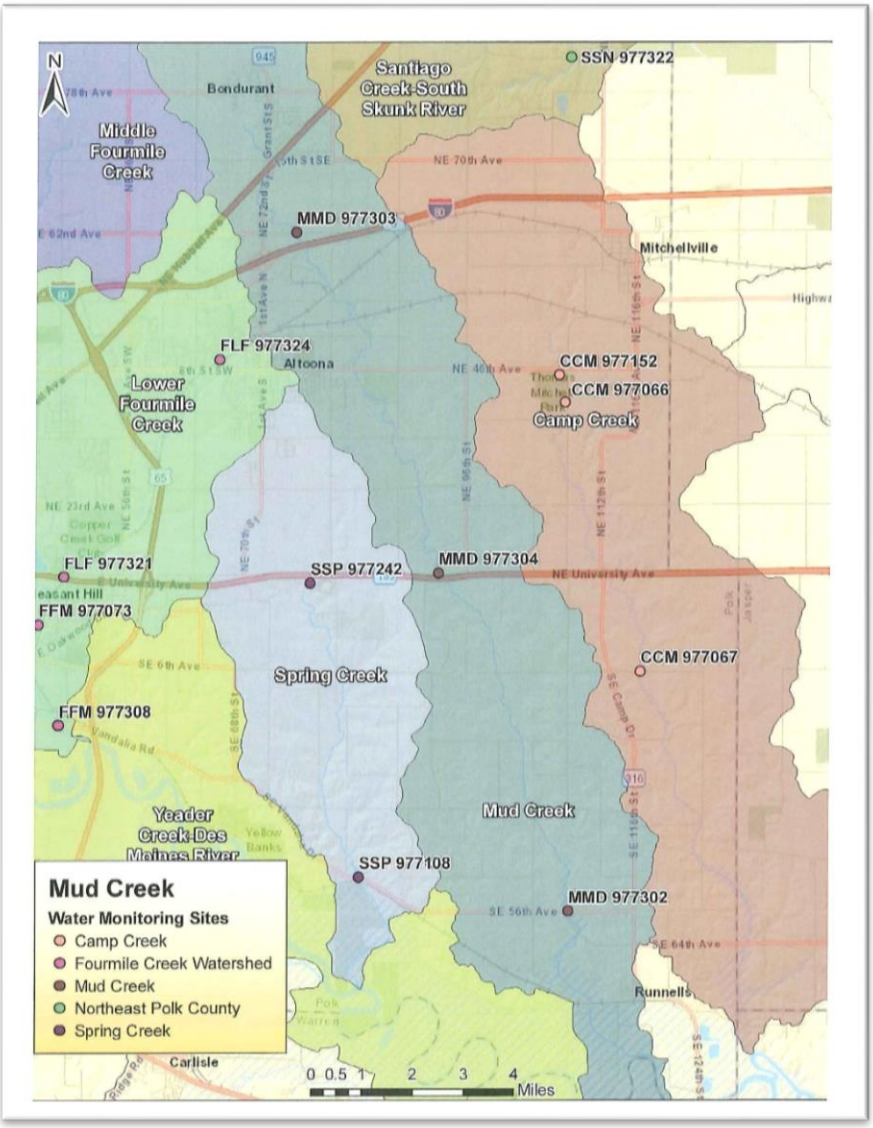

Figure 42. Mud Creek Water Quality Monitoring Sites

Three sites are monitored in Mud Creek. Site 977303 is south of Bondurant just north of Interstate 80. Site 977304 is located along Highway 163 and site 977302 is near the southeast county boundary (Fig. 42).

The two sites furthest upstream had the highest occurrence of abnormal readings. Site 977302, the site furthest downstream, was normal throughout the year.

Dissolved oxygen concentrations at the three Mud Creek locations remained mostly in the normal range throughout the year (Fig. 49). High nitrate, phosphate and chloride concentrations were reported in spring, summer and late fall (Figs. 46, 47 & 50). High phosphate concentrations are likely due to fertilizer and soil picked up by runoff for all Mud Creek sites as the area is primarily agricultural.

Benthic macroinvertebrates of high- and middle-quality groups were found at each site indicating an overall healthy stream of good water quality. The IBI results of 2.5 and 2.44 for sites 977302 and 977304 indicate good health and are some of the highest results for all monitored sites. The IBI of 2.07 for site 977303 fell in the fair benthic macroinvertebrate range.

Figure 43. Mud Creek Site 977302

Figure 44. Mud Creek Site 977303

Figure 45. Mud Creek Site 977304

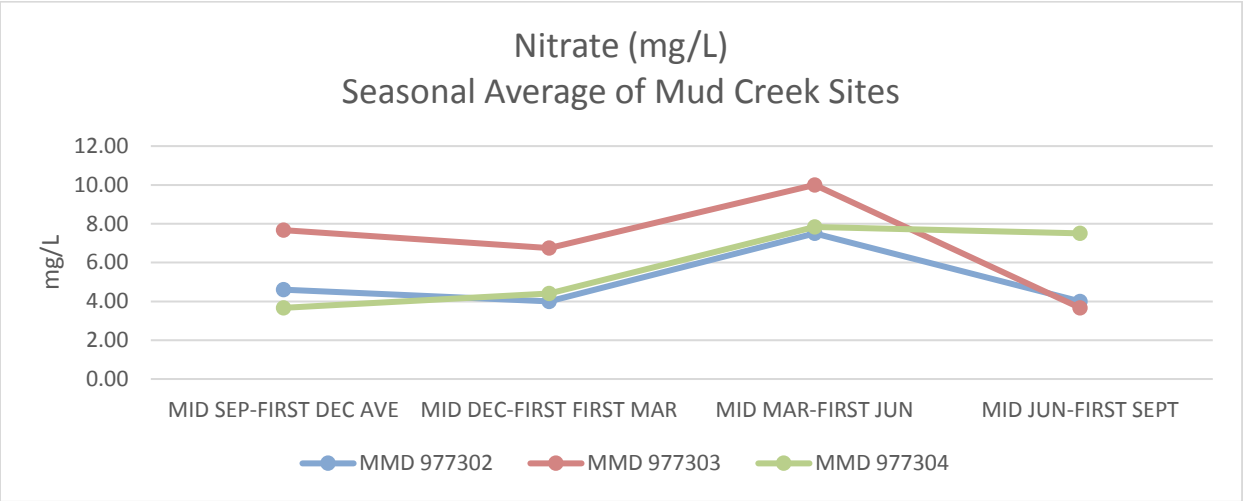

Figure 46. Seasonal Average Nitrate Concentrations for Mud Creek Mid-September 2016 Through Mid-September 2017

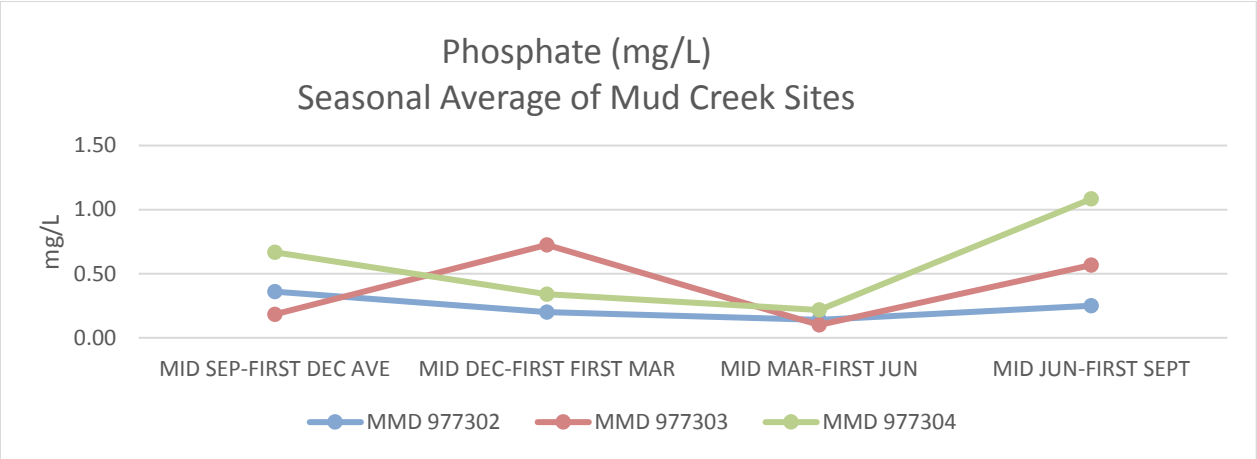

Figure 47. Seasonal Average Phosphate Concentrations for Mud Creek Mid-September 2016 Through Mid-September 2017

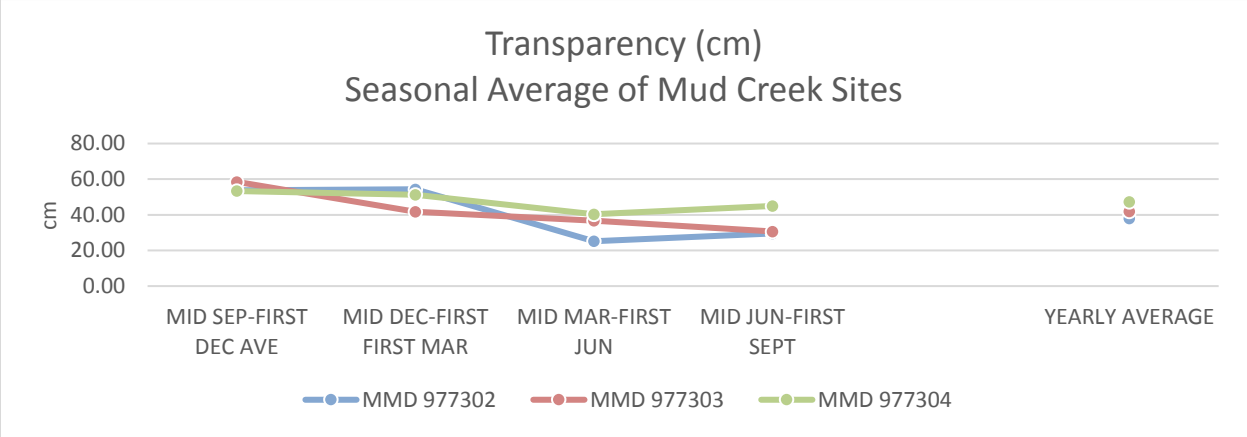

Figure 48. Seasonal Average Transparency for Mud Creek Mid-September 2016 Through Mid-September 2017

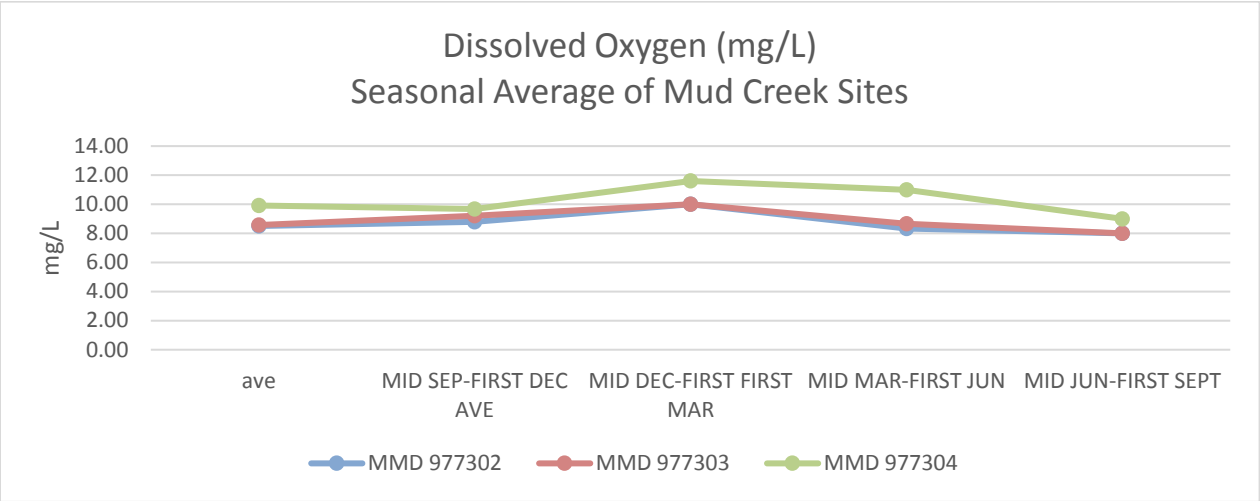

Figure 49. Seasonal Average Dissolved Oxygen Concentrations for Mud Creek Mid-September 2016 Through Mid-September 2017

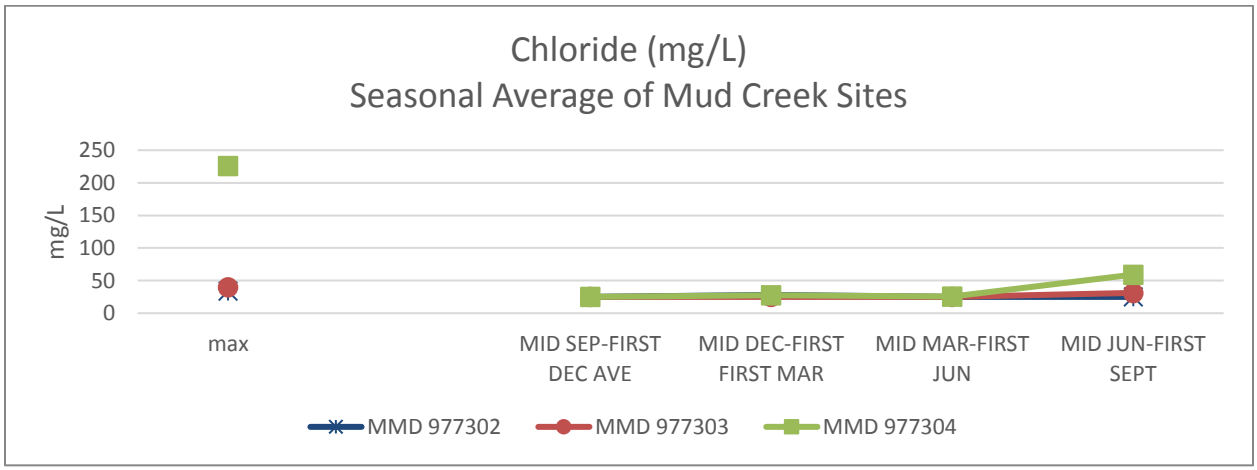

Figure 50. Seasonal Average Chloride Concentrations for Mud Creek Mid-September 2016 Through Mid-September 2017

Spring Creek

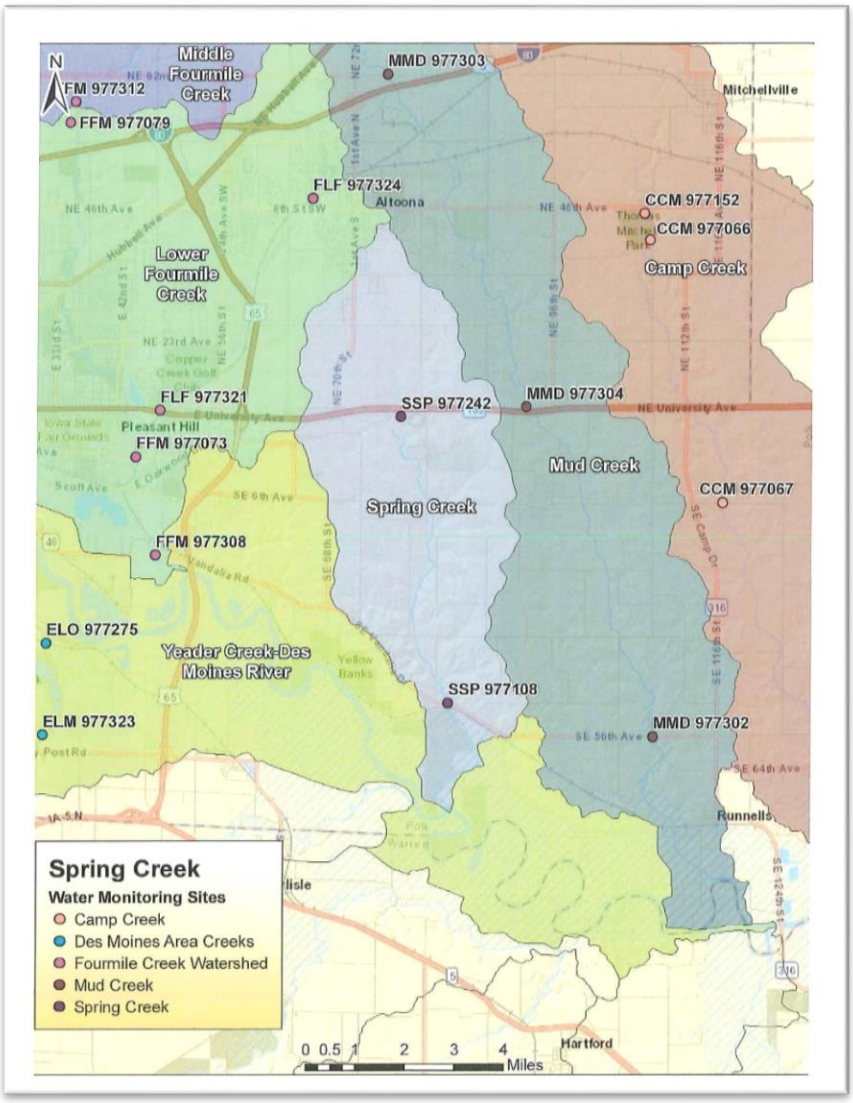

Figure 51. Spring Creek Water Quality Monitoring Sites

Figure 52. Spring Creek Site 977242

Spring Creek Site 977242 is located south of Highway 163 near Southeast Polk High School (Fig. 51). Downstream ten miles on Vandalia Drive is site 977108 (Fig. 51). Both sites are located in a mostly rural area.

Phosphate concentration were high in January at site 977242 (Fig. 55). This site was dry during the drought in August 2017. The pH was slightly below normal, or slightly acidic, once in January at site 977108.

Benthic macroinvertebrates from all quality groups were found at both sites. The IBI results of 1.84 and 2.00 for sites 977108 and 977242 fell in the fair benthic macroinvertebrate range. As no significant issues were found at either of the two water monitoring sites, the creek is considered safe for recreational use.

Figure 53. Spring Creek Site 977108

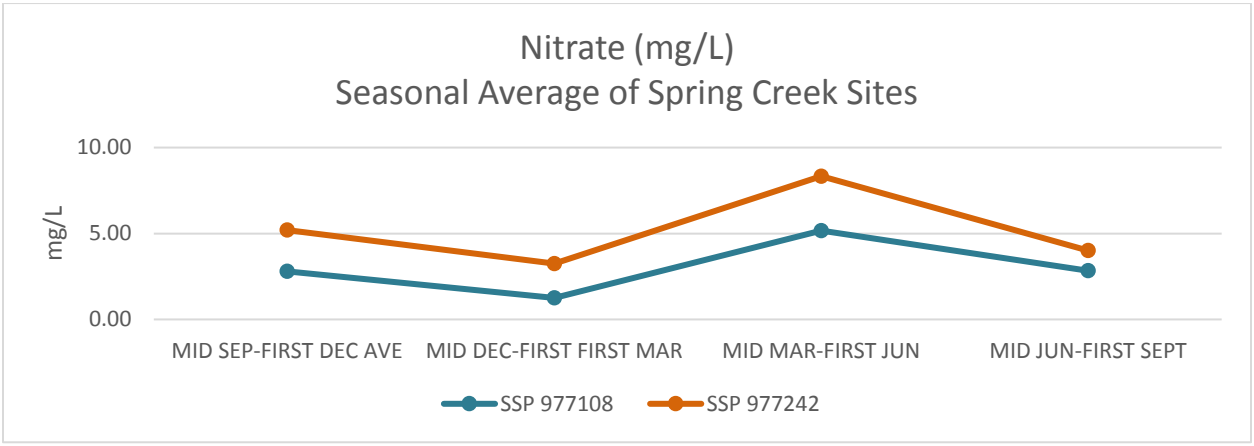

Figure 54. Seasonal Average Nitrate Concentrations for Spring Creek Mid-September 2016 Through Mid-September 2017

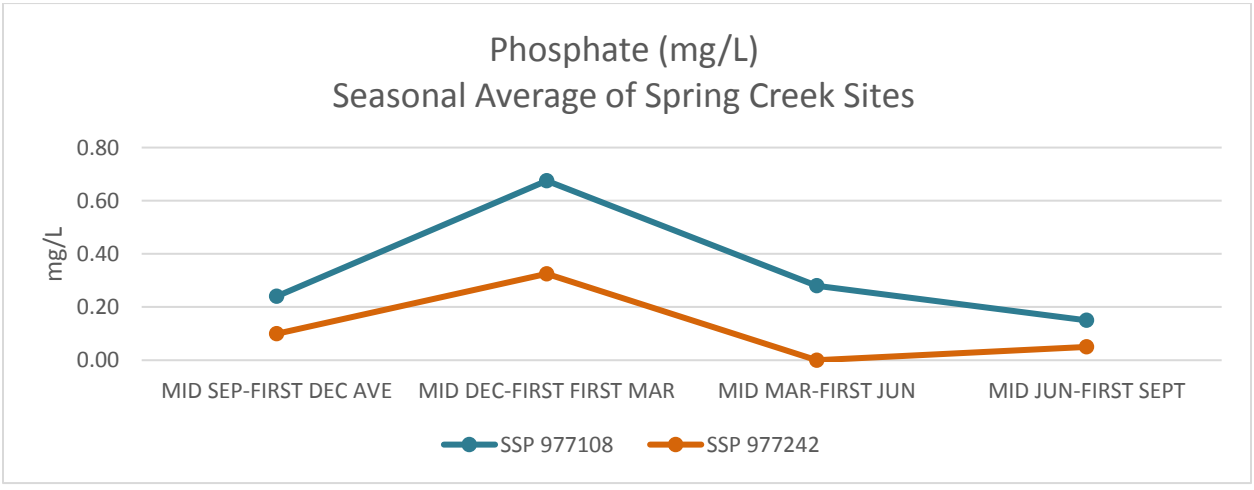

Figure 55. Seasonal Average Phosphate Concentrations for Spring Creek Mid-September 2016 Through Mid-September 2017

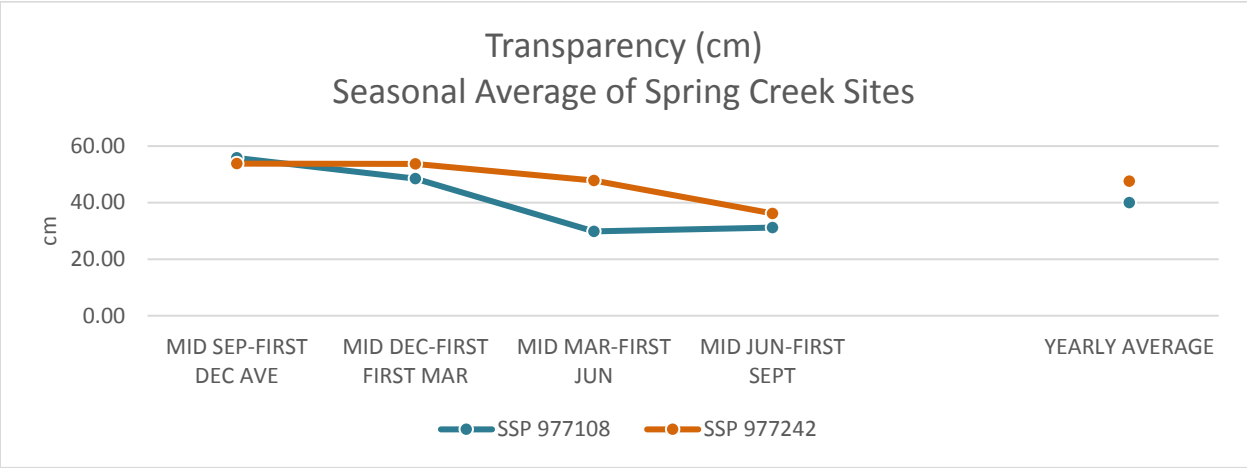

Figure 56. Seasonal Average Transparency for Spring Creek Mid-September 2016 Through Mid-September 2017

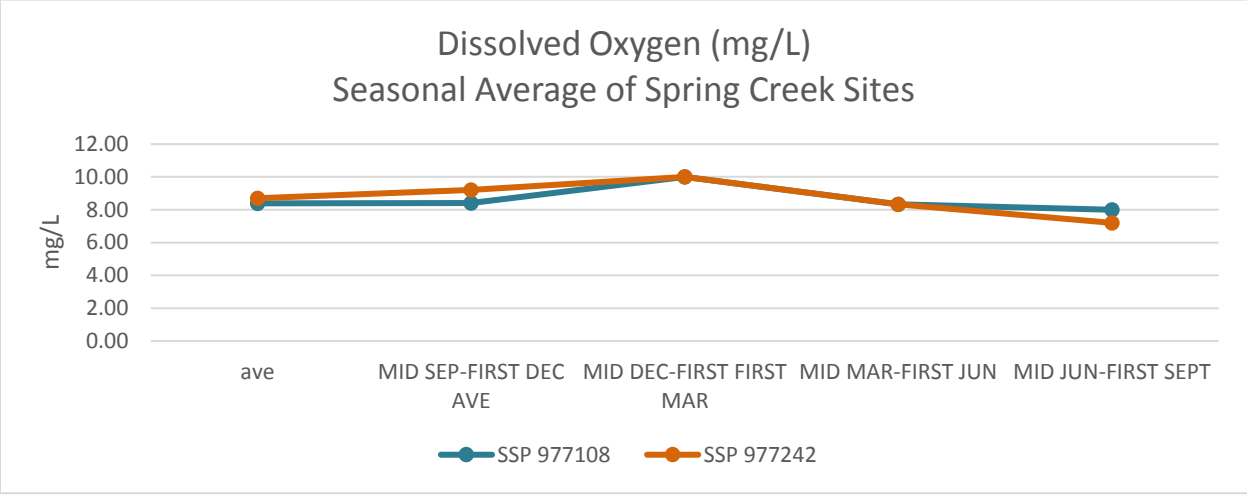

Figure 57. Seasonal Average Dissolved Oxygen Concentrations for Spring Creek Mid-September 2016 -Mid-September 2017

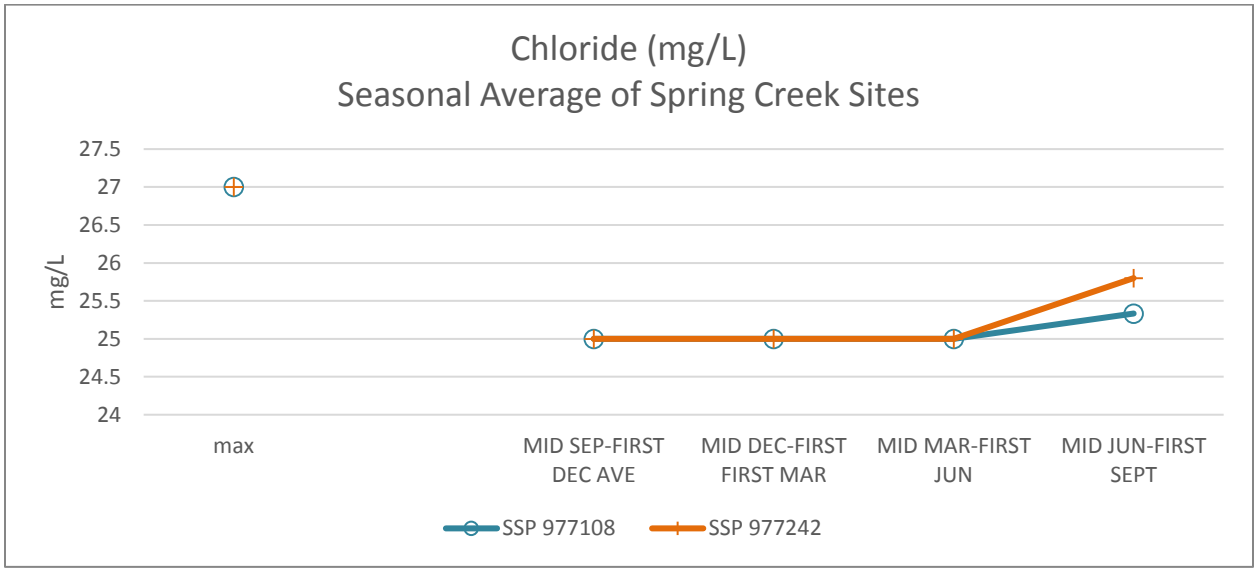

Figure 58. Seasonal Average Chloride Concentrations for Spring Creek Mid-September 2016 Through Mid-September 2017

Northeast Polk County- Drainage Ditches 4 and 38, Bluff, Carney, Indian and Santiago Creeks

Site Number	Creek Name	Site Name
IIN 977327	Indian Creek	Indian Creek at NE 162nd Av
CCR 977307	Carney Creek	Carney Creek at Buttonbush
C04 977310	Drainage Ditch	DD4 - Control Marsh
CBL 977306	Bluff Creek	Bluff Creek - 118th
C38 977311	Drainage Ditch	Drainage Ditch 38
CBL 977306	Bluff Creek	Bluff Creek - 118th
SSN 977322	Santiago Creek	Santiago Creek at Bridge Near NE 82nd Ave

Table 4. Northeast Polk County Water Quality Monitoring Sites

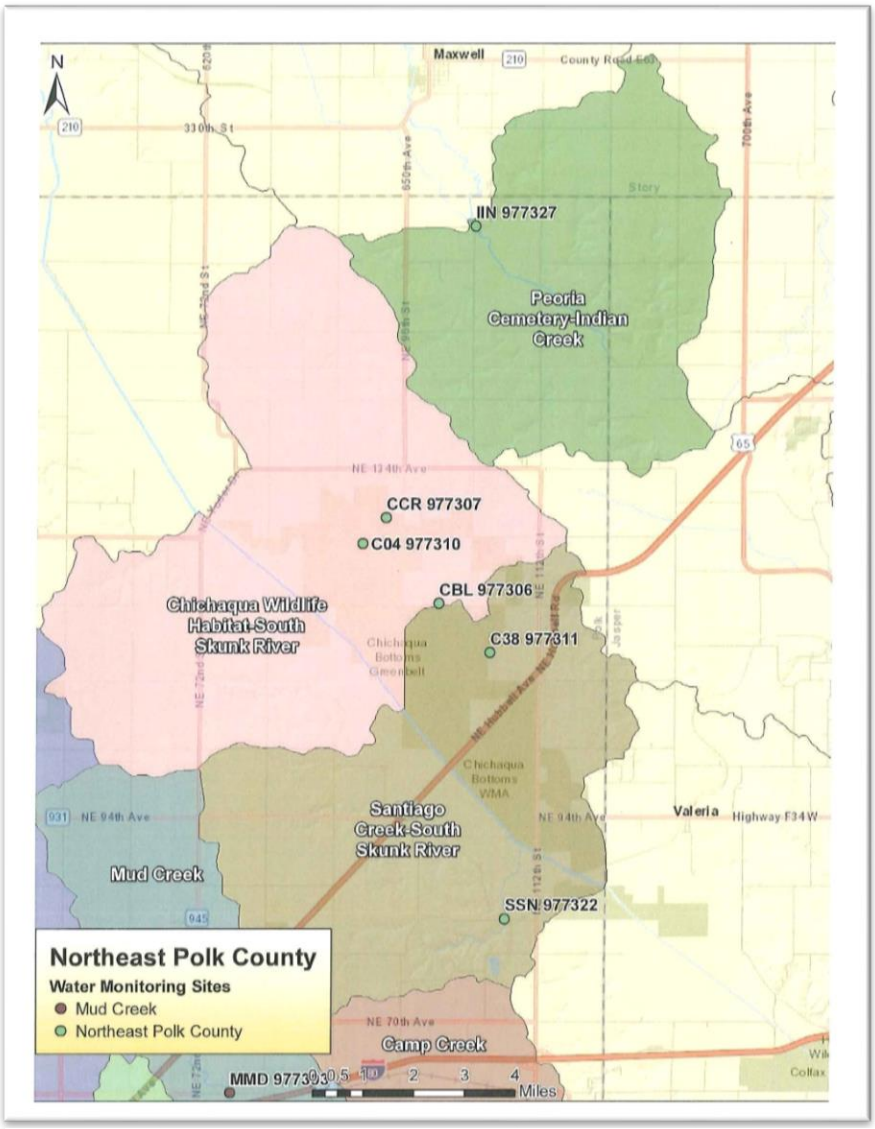

Figure 59. Water Quality Monitoring Sites in Northeast Polk County

Six sites are monitored in far northeast Polk County, one each on Bluff Creek, Carney Creek, Indian Creek and Santiago Creek and Drainage Ditches 4 and 38 (Fig. 59). Monitoring began in Indian Creek and in Santiago Creek, in June 2017. This area is primarily rural agricultural land.

Dissolved oxygen concentrations were dangerously low, 2-5 mg/L, throughout the year at all sites except the Carney Creek site 977307 (Fig. 68). Chloride concentrations at all sites remained low throughout the year (Fig. 69). Nitrate concentrations for all sites except Santiago Creek were among the lowest readings of all PCCWQMP sites throughout the year despite being a largely rural area (Fig. 65). This Santiago Creek site is

located within Chichaqua Bottoms Greenbelt. The substrate (logs, grass, etc.) found in the park creek bed has shown a cleansing effect on the water resulting in consistently low nitrate results. Phosphate concentrations at all monitored sites except Indian Creek were found at or below the 0.6 mg/L threshold (Fig. 66).

Biological assessments were completed in mid-July 2017. All sites had benthic macroinvertebrates in the BMI middle-quality group. Very few high-quality group benthic macroinvertebrates were found.

Figure 60. Indian Creek Site 977327

Monitoring began on Indian Creek site 977327 in mid-June 2017 (Fig. 60). This site experienced high phosphate levels, ranging between 1 mg/L and 5 mg/L, well over the 0.6mg/L threshold (Fig. 66). The site experienced low dissolved oxygen concentrations in July 2017 (Fig. 68).

Indian Creek's IBI was zero due to very low numbers of benthic macroinvertebrates found at the site. This may indicate a degraded habitat, higher levels of pollution or may be a result of the low water levels and drought.

Figure 61. Carney Creek Site 977307

Carney Creek Site 977307 (Fig. 61) reported "clear" water color throughout the year, even after rain. This heavily vegetated site flows through well-managed pastureland before entering Chichaqua Bottoms Greenbelt. This decreases sediment load in runoff resulting in clearer water when other more eroded and less vegetated creeks will carry sediment after rainfall.

Phosphate concentrations were slightly elevated in September, January, June, and July (Fig. 66). Chloride concentrations remained low, well below the normal range (Fig. 69). Low dissolved oxygen and slightly above normal nitrate and phosphate concentrations were reported in July, likely due to lower than normal stream flow, shallow depths and rising water temperatures common during summer (Fig. 68, 65, 66). The creek went dry in August and remained dry through the rest of our reporting period.

Carney Creek site 977307 reported an IBI of 1.33, which indicates a poor benthic macroinvertebrate population present. This is likely the result of the low water levels and drought conditions.

Figure 62. Drainage Ditch 4 Site 977310

Drainage Ditch 4 Site 977310 (Fig. 62) consistently reported low dissolved oxygen throughout the year (Fig. 68). Phosphate concentrations were low through most of the year with slightly elevated levels in fall 2016 and in summer 2017 and once in January 2017 (Fig. 66). Seasonal averages for nitrates ranged from 0 to 5 mg/L, well below the drinking standard of 10 mg/L (Fig. 65). Chloride readings were consistently low throughout the year (Fig. 69). This site was dry for the last two monitoring events in August and September 2017.

Despite low dissolved oxygen results and drought conditions that resulted in a dry creek bed in late August and September the IBI of near 2.0 indicated the presence of a fair benthic macroinvertebrate population present.

Figure 63. Bluff Creek Site 977306

Bluff Creek Site 977306 (Fig. 63) reported abnormally low dissolved oxygen in fall 2016 and late spring through the rest of the year, characteristic of shallow and warm streams (Fig. 68). Monitoring was not possible in mid-December through January when the creek froze. Nitrate, phosphate and chloride concentrations were normal throughout the year (Figs. 65, 66 & 69).

This site is heavily vegetated which decreases the sediment load in runoff from adjacent agricultural land. The site was dry during September 2017.

The biological assessment resulted in an IBI of 1.44 indicating a poor benthic macroinvertebrate population for Bluff Creek site 977306.

Figure 64. Low Water at Drainage Ditch 38 Site 977311

Drainage Ditch 38 Site 977311 (Fig. 64) reported very low dissolved oxygen throughout the year (Fig. 68). Green, reddish, milky and oily water throughout the winter and again in the summer were noted. Algal mats present in summer assessments and low dissolved oxygen results with an oily sheen were reported to the Iowa DNR. This site went dry in August and remained dry through the rest of the monitoring period.

The biological assessment resulted in an IBI of 2.11 indicating a fair benthic macroinvertebrate population at site 977311.

Monitoring on Santiago Creek Site 977322 began in June, 2017 (Fig. 65). Only three assessments were obtained before the creek went dry in August 2017 and remained dry through the 2016-17 reporting period. High nitrates were reported in June (Fig. 66). Low dissolved oxygen and high phosphates occurred in July due to drought conditions (Figs. 67 & 69).

The biological assessment resulted in an IBI of 2.00 indicating a fair benthic macroinvertebrate population for site 977322.

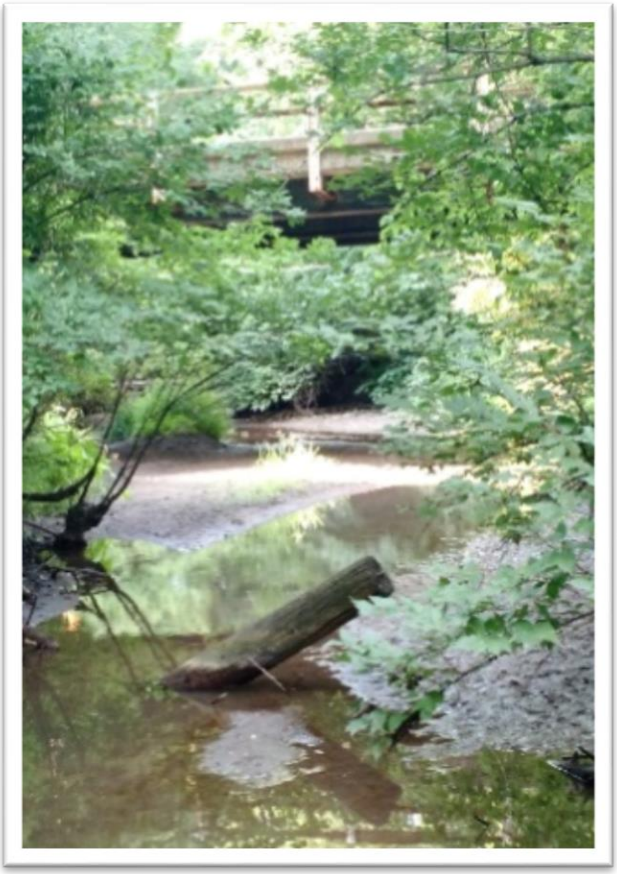

Figure 65. Santiago Creek Site 977322

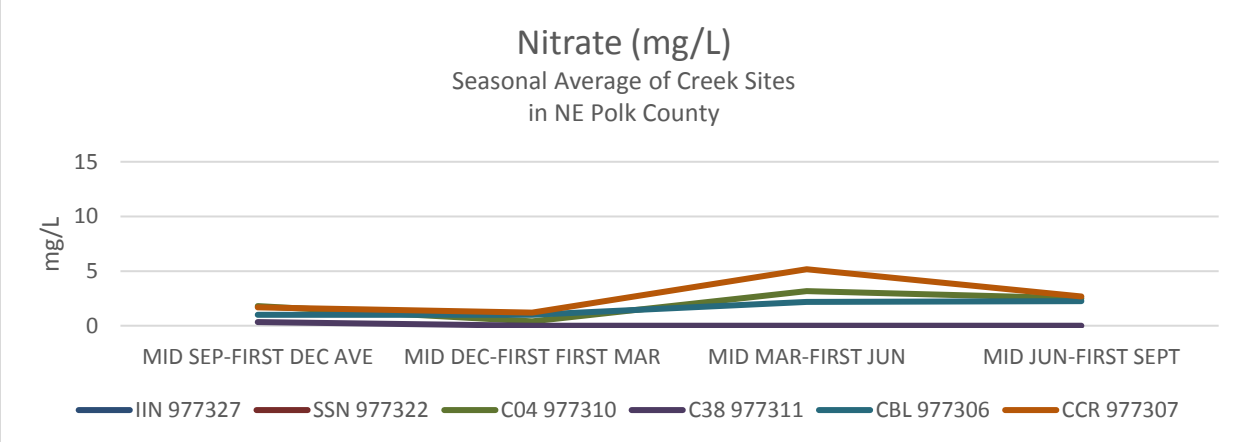

Figure 66. Seasonal Average Nitrate Concentrations for NE Polk County Creek Sites Mid-September 2016 Through Mid-September 2017

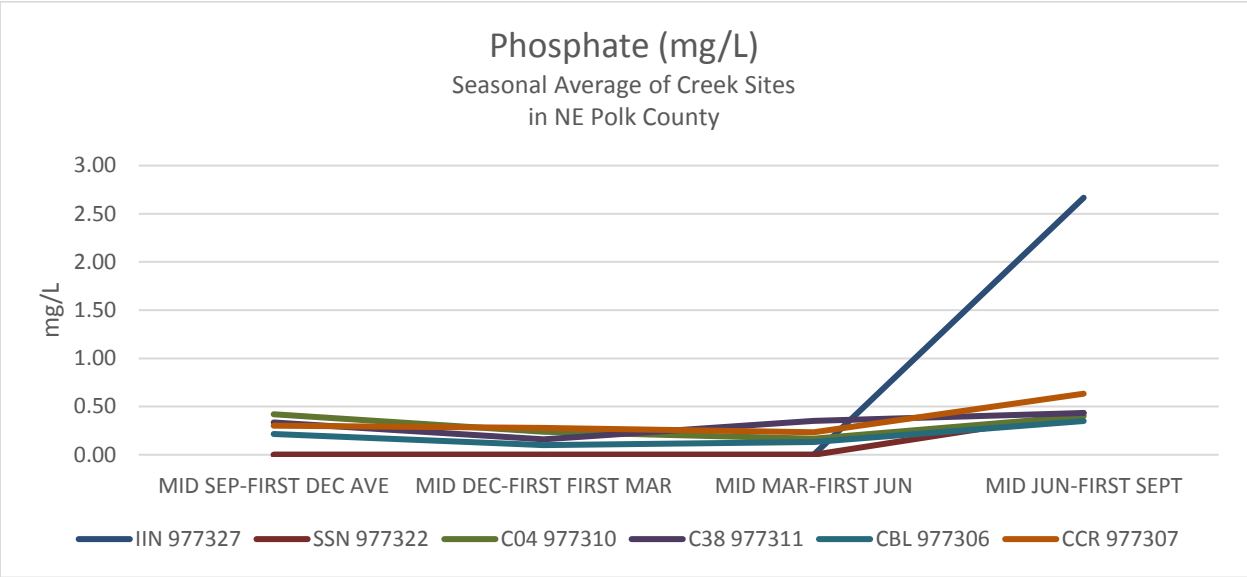

Figure 67. Seasonal Average Phosphate Concentrations for NE Polk County Sites Mid-September 2016-Mid-September 2017

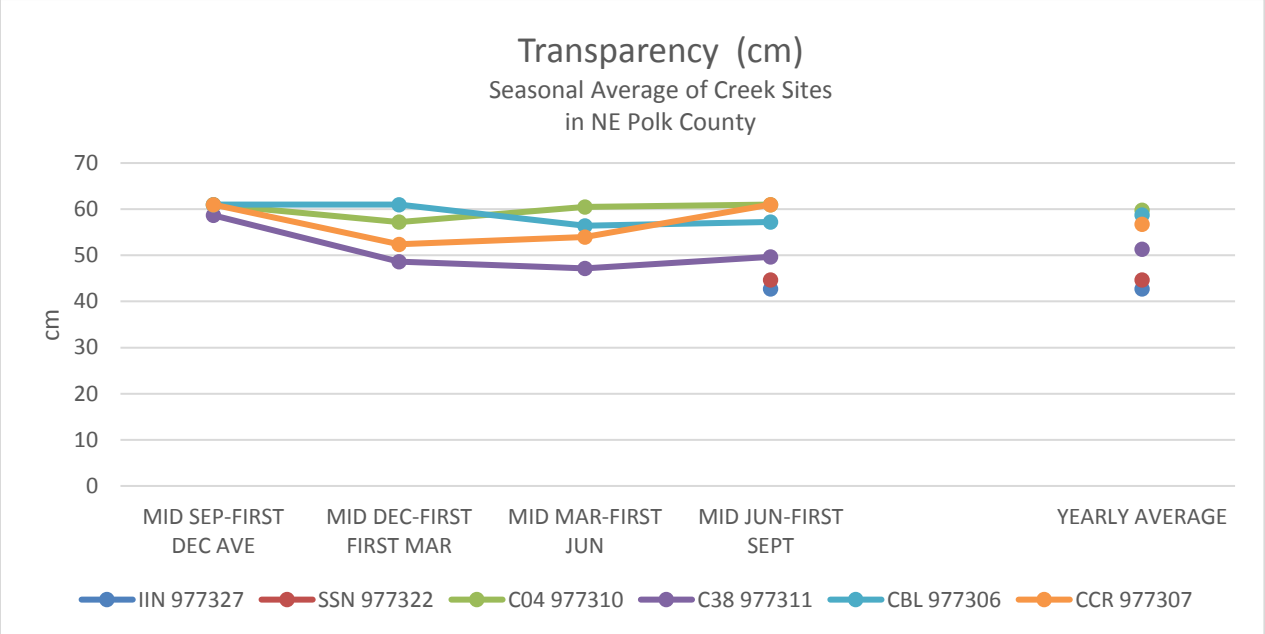

Figure 68. Seasonal Average Transparency for NE Polk County Creek Sites Mid-September 2016 - Mid-September 2017

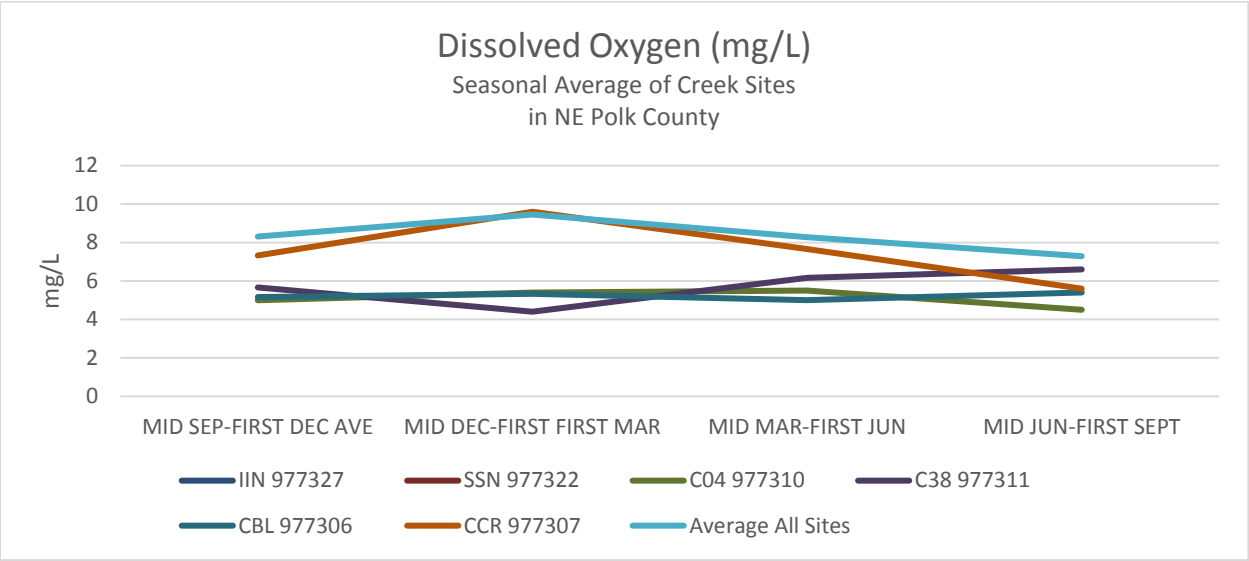

Figure 69. Seasonal Average Dissolved Oxygen Concentrations for NE Polk County Sites Mid-September 2016-Mid-September 2017

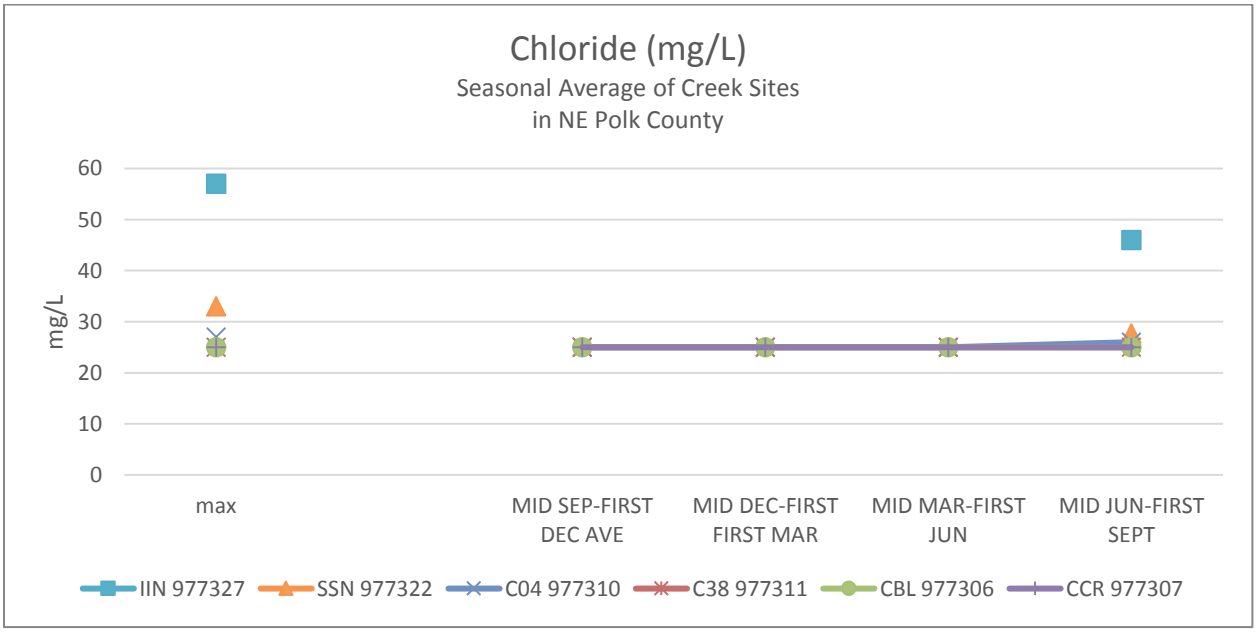

Figure 70. Seasonal Average Chloride Concentrations for NE Polk County Creek Sites Mid-September 2016 -Mid-September 2017

Des Moines Area Creeks

Site Number	Watershed/Area	Creek Name	Site Name
CLI 977326	Case Lake	Case Lake Inflow	Case Lake Inflow
CCW 977325	Crawford Creek	Crawford Creek	Crawford Creek at SE 9th
ELM 977323	Easter Lake	Magnolia Creek	"Unnamed Creek" at Three Lakes Estates
ELO 977275	Easter Lake	Unnamed Creek	Easter Lake Outlet
FFR 977082	Frink Creek	Frink Creek	Near Gay Lea Wilson Trail and SW 42nd
GLU 977012	Gray's Lake	Unnamed Creek-Into Gray's Lake	Unnamed Creek - Trib. to Grays Lake

Table 5. Des Moines Area Water Quality Monitoring Sites

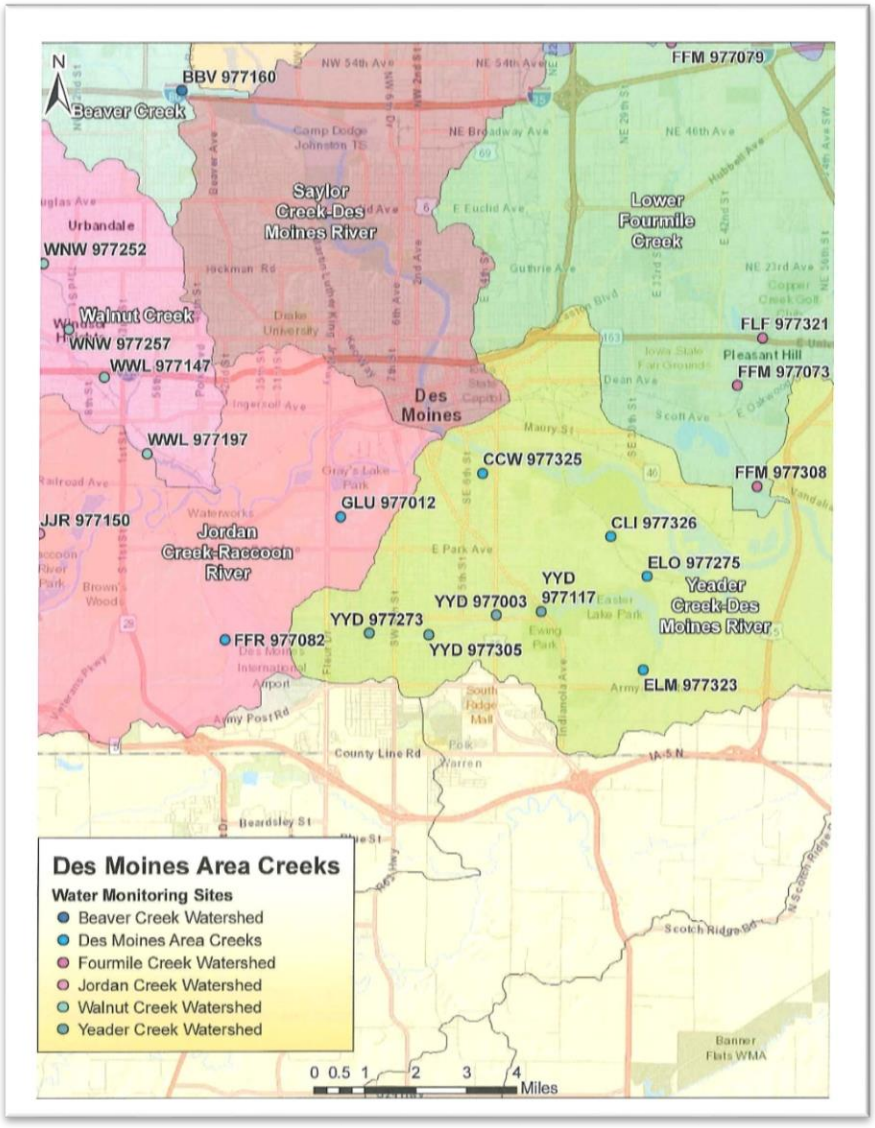

Figure 71. Des Moines Area Water Quality Monitoring Sites

Six sites in the Des Moines area on various watersheds were added in July and August 2017 (Fig. 71). Frink Creek Site 977082 and the unnamed creek near Gray's Lake Site 977012 are in the Raccoon River watershed. Magnolia Creek Site 977323 (Easter Lake Area), Crawford Creek Site 977325, Case Lake Inflow Site 977326 and Easter Lake Outflow Site 977275 flow into the Des Moines River watershed.

Biological assessments were completed for four of the six Des Moines area sites. Magnolia Creek Site 977323 and Crawford Creek Site 977325 both reported fair IBI results indicating a fair benthic macroinvertebrate population is present in these areas. Frink Creek Site 977082 and Case Lake Inflow Site 977326 IBI results fell in the poor range. No biological assessments were completed for Easter Lake Outlet Site 977275 and the unnamed creek near Gray's Lake Site 977012.

Figure 72. Case Lake Inflow Site 977326

Case Lake Inflow Site 977326 (Fig. 72) is located south of James W. Cownie Soccer Park on Hartford Avenue in Des Moines. Three field assessment forms were completed during this reporting period. These results were normal with the exception of a low dissolved oxygen result of 3 mg/L in July (Fig. 80) and a high phosphate concentration of 0.6 mg/L in August (Fig. 78).

The biological assessment resulted in an IBI of 1.6 indicating a poor benthic macroinvertebrate population for Case Lake Inflow site 977326.

Figure 73. Crawford Creek Site 977325

Crawford Creek Site 977325 (Fig. 73) is located on the west side of Southeast Ninth Street between East Edison Avenue and East Hillside Avenue. This creek flows northeast into the flood control structure prior to going into the Des Moines River. Four field assessment forms were completed, however once during the September assessment the creek was dry. The results were normal with the exception of a pH result of 5 in early July.

The biological assessment resulted in an IBI of 2.0 indicating a fair benthic macroinvertebrate population at Crawford Creek site 977325.

Figure 74. Magnolia Creek Site 977323

Magnolia Creek Site 977323 (Fig. 74), located in Three Lakes Estates along Southeast 60th Avenue, began monitoring in early July. The four completed assessments did not report any abnormal results.

The biological assessment resulted in an IBI of 2 indicating a fair benthic macroinvertebrate population for Magnolia Creek site 977323.

Figure 75. Easter Lake Outlet Site 977275

Easter Lake Outlet Site 977275 (Fig. 75) is north of Easter Lake at Hartford Avenue. Monitoring at the site began in August 2017. No abnormal readings were recorded on either of the two site assessments completed.

No biological assessment form was filled out for this site in 2017.

Site 977012 (no photograph available) is on the unnamed creek at the First Unitarian Church which flows from a residential neighborhood to Gray's Lake. This site was monitored once in July and again in September. The results were within the normal range with the exception of low dissolved oxygen and high phosphate in July (Fig. 79).

A biological assessment form was not completed at this site. No photograph is available at this time.

Monitoring on the Frink Creek Site 977082 (Fig. 76) began in early July 2017. All results on the four completed assessments were within normal range.

The biological assessment resulted in an IBI of 1.6 indicating a poor benthic macroinvertebrate population for Frink Creek Site 977082.

Figure 76. Frink Creek Site 977082

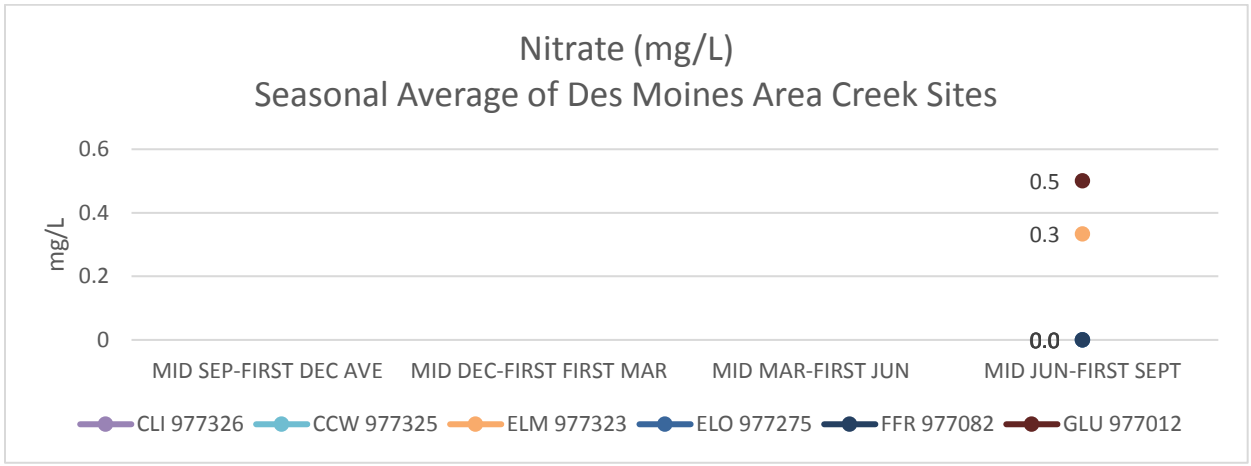

Figure 77. Seasonal Average Nitrate Concentrations for Des Moines Area Creek Sites Mid-September 2016 - Mid-September 2017

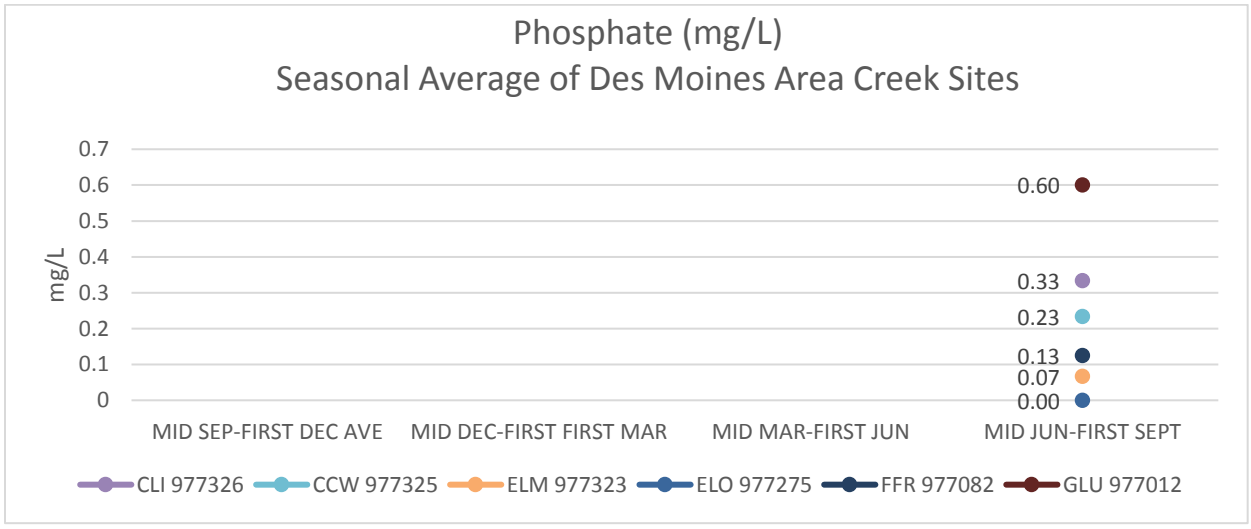

Figure 78. Seasonal Average Phosphate Concentrations for Des Moines Area Creek Sites Mid-September 2016 - Mid-September 2017

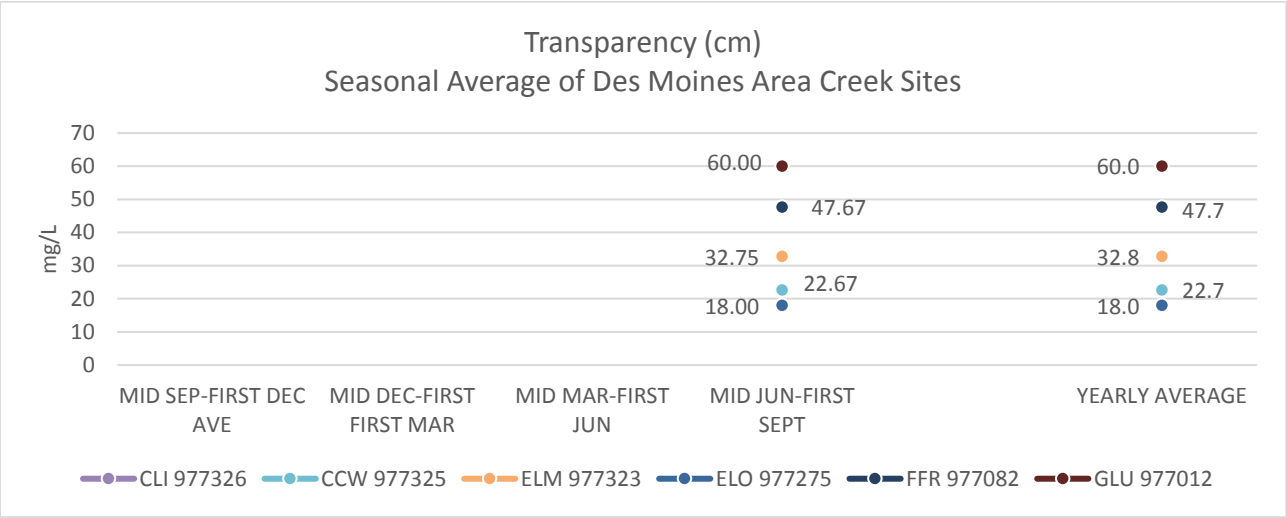

Figure 79. Seasonal Average Transparency for Des Moines Area Creek Sites Mid-September 2016 - Mid-September 2017

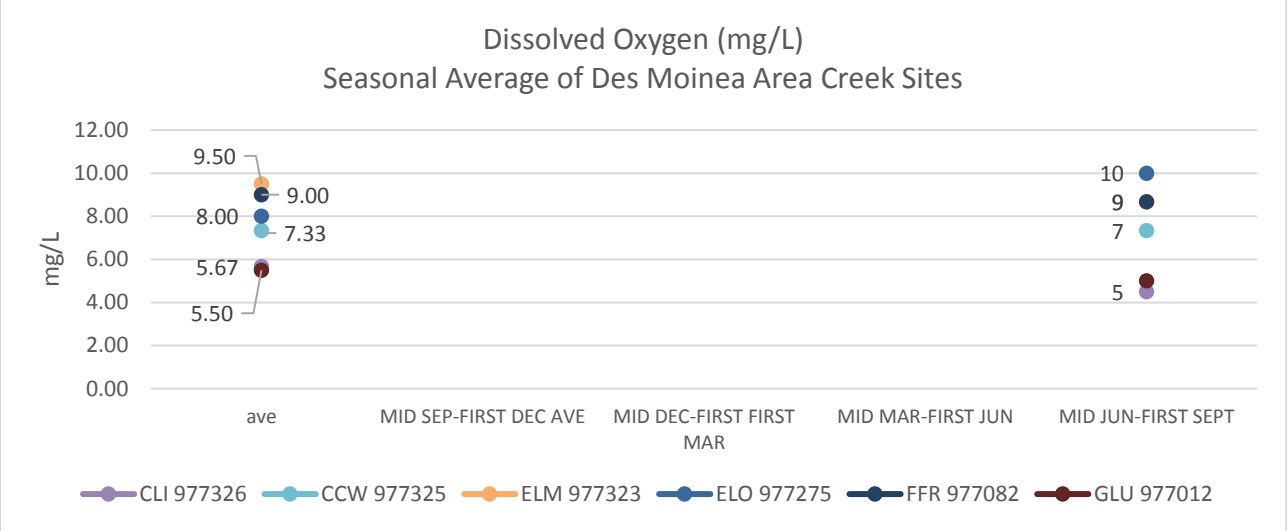

Figure 80. Seasonal Average Dissolved Oxygen Concentrations for Des Moines Sites Mid-September 2016-Mid-September 2017

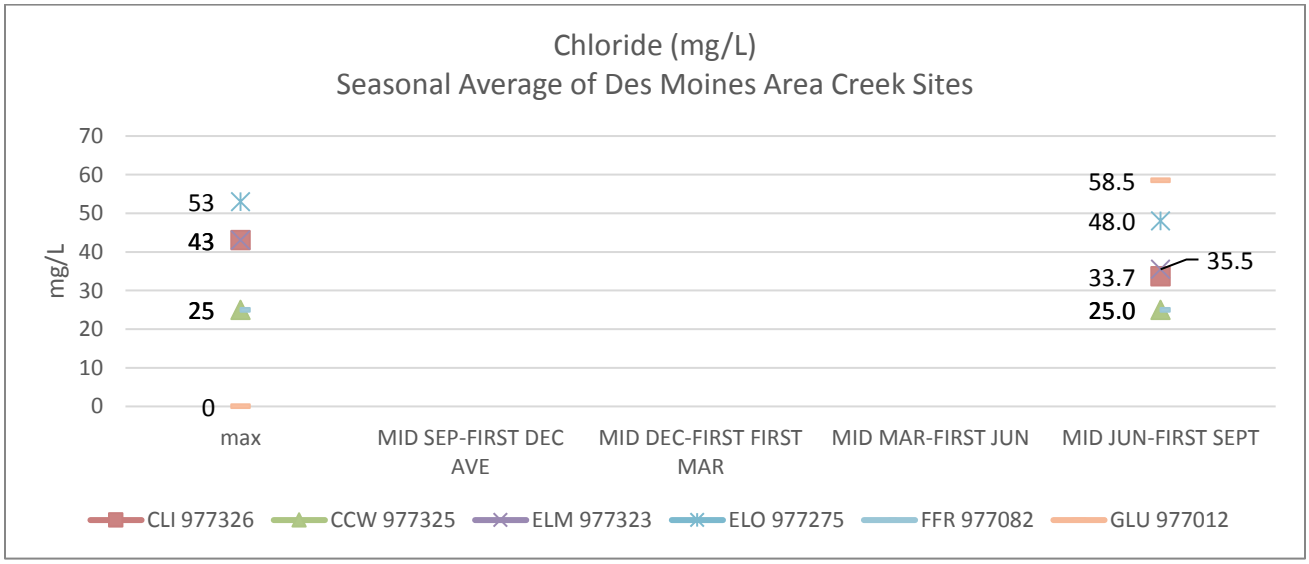

Figure 81. Seasonal Average Chloride Concentrations for Des Moines Sites mid-September 2016 - Mid-September 2017

Fourmile Creek Watershed

Site Number	Creek Name	Site Name
FDR 977309	Fourmile Creek Trib-Deer Cr	Deer Creek
FFM 977072	Fourmile Creek	Polk County Snapshot (Site FMC1 - Fourmile Creek)
FFM 977073	Fourmile Creek	Polk County Snapshot (Site FMC10 - Fourmile Creek)
FFM 977075	Fourmile Creek	Polk County Snapshot (Site FMC3 - Fourmile Creek)
FFM 977078	Fourmile Creek	Polk County Snapshot (Site FMC6 - Fourmile Creek)
FFM 977079	Fourmile Creek	Polk County Snapshot (Site FMC7 - Fourmile Creek)
FFM 977301	Fourmile Creek	4 Mile Creek
FFM 977308	Fourmile Creek	4 Mi Creek - Vandalia Av
FFM 977312	Fourmile Creek	Muchiknock Creek at 4Mi Creek
FLF 977321	Little Fourmile Creek	Little Fourmile Creek at E University in Pleasant Hill
FLF 977324	Little Fourmile Creek	Little Fourmile Creek at Lyons Park

Table 6. Fourmile Creek Water Quality Monitoring Sites

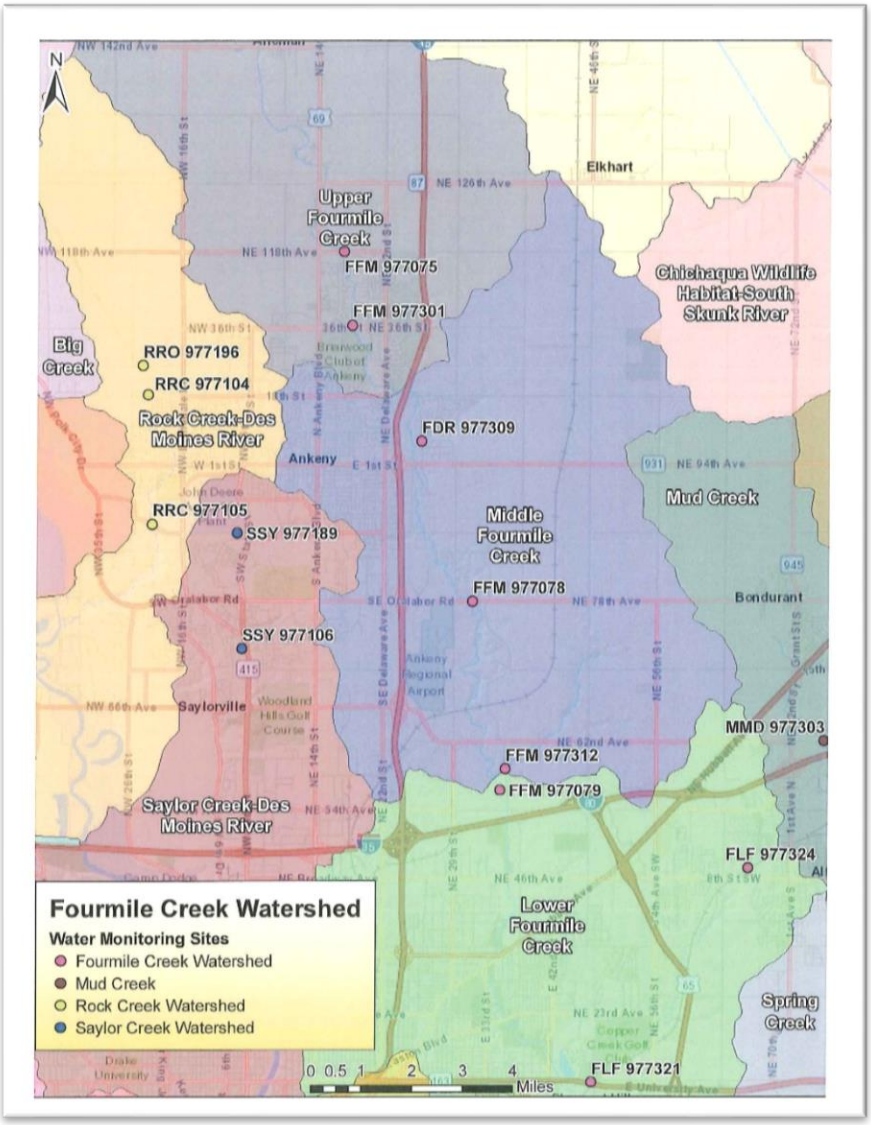

Figure 82. Fourmile Creek Watershed Water Quality

Fourmile Creek watershed is comprised of 76,600 acres of urban and agricultural land (Fig. 82). PCCWQP monitoring captured information at eleven sites in the Fourmile Creek watershed beginning in far north central Polk County southeast of Slater and continuing through the county to its intersection with the Des Moines River in the southern portion of the county.

Six sites were regularly monitored twice a month from mid-September 2016 through mid-September 2017. One site was under construction most of the year with only one assessment completed in March 2017. Four sites were added in the Fourmile Creek watershed

in summer of 2017. The spring seasonal average nitrate concentration was at or slighter higher than the drinking water threshold on three of the six sites that were monitored all year (Fig. 92). All sites reported normal pH concentrations throughout the year until late summer when two sites had levels below normal. Dissolved oxygen concentrations were normal until summer when five below normal results were recorded (3-5 mg/L) (Fig. 94). Phosphate concentrations were elevated throughout the year on Fourmile Creek watershed sites. Of the six sites monitored all year, five reported seasonal phosphate averages above the threshold of 0.6 mg/L (Fig. 92) Chloride concentrations above the 100 mg/L threshold occurred in late summer 2017 at three sites with readings ranging 115 to 226 mg/L (Fig. 95).

Biological assessments were completed for eight sites. Of the completed assessments, one site did not find any benthic macroinvertebrates and two found very small numbers of high-quality benthic macroinvertebrates. The resulting IBI for each assessment indicated poor to fair benthic macroinvertebrate populations present.

Figure 83. Fourmile Creek Site 977072

Fourmile Creek Site 977072 (Fig. 83) is by far the most rural sampling site in the Fourmile Creek watershed and is the only site which experienced high phosphate concentrations throughout much of the year (Fig. 93). High nitrate readings of 10 mg/L occurred spring through summer with one 20 mg/L concentration in May 2017 (Fig. 92). A manure smell and very high chloride concentration occurred in July during low creek flow.

Benthic macroinvertebrates were present from the BMI middle- and low-quality groups indicating some degree of pollution and habitat degradation. The IBI of 1.31 would indicate a poor benthic macroinvertebrate population present.

Figure 84. Fourmile Creek Site 977301

Monitoring at site Fourmile Creek Site 977301 (Fig. 83) in northern Ankeny was suspended due to bridge construction. One field assessment was completed in March 2017.

No Biological Assessment was completed at this site due site closure.

Figure 85. Fourmile Creek Site 977309

Deer Creek Site 977309 (Fig. 85) is located upstream of its confluence with Fourmile Creek in Ankeny. This site reported higher than normal phosphate concentrations in January 2017 (Fig. 93). Nitrate levels were above drinking water standard in fall 2016 and spring through summer 2017 with a very high reading in May 2017 (Fig. 92). Upstream from the site are housing developments and agricultural land.

A biological assessment was completed in July 2017. Species were found from BMI middle-quality group BMI low-quality group. The IBI for this site indicated a poor benthic macroinvertebrate population present.

Fourmile Creek Site 977079 (Fig. 86) located in Mally's Weh Weh Neh Kee Park and Muchinknock Creek Site 977312 (no photo) also had higher than normal phosphate concentrations in fall 2016 and summer 2017 (Fig. 93). Nitrate, pH and chloride concentrations remained normal at these sites.

Figure 86. Fourmile Creek Site 977079

A biological assessment was completed in July 2017 for site 977312. The benthic macroinvertebrates found in the 2015-16 assessment indicated good water quality but the IBI for 2016-17 indicates a poor benthic macroinvertebrate population. This is likely to due to low rainfall throughout the area during the summer of 2017. A biological assessment was not completed for site 977079.

Fourmile Creek Site 977073 (Fig. 87), located near Sleepy Hollow, and Fourmile Creek Site 977308 (Fig. 88), at Vandalia Road near Highway 65, had normal nitrate, pH and dissolved oxygen readings all year. Phosphate concentrations at these sites, like most PCCWQMP sites, were high in January 2017 (Fig. 93). Site 977073 reported one spike in chloride concentration (115 mg/L) in September 2017 when water flow was at its lowest (Fig. 95).

Figure 87. Fourmile Creek Site 977073

A biological assessment was completed for site 977073. Benthic macroinvertebrates were present from all BMI quality groups. The IBI of 2.0 would indicate a fair benthic macroinvertebrate population present at this time.

Site 977308 (Fig. 88) did not have a biological assessment completed in 2017.

Figure 88. Fourmile Creek Site 977308

Figure 89. Fourmile Creek Site 977075

Fourmile Creek site 977075 (Fig. 89) is located in northern Ankeny along the edge of a residential area. Upstream from the site is agricultural land. Monitoring began on this site in mid-July. This site reported low dissolved oxygen in July and August (Fig. 94). Only two assessments were completed before it went dry in September 2017.

A biological assessment was completed for this site. Species found were from the BMI low-quality group. The resulting IBI of 1.05 for this site indicated a poor benthic macroinvertebrate population.

Figure 90. Fourmile Creek Site 977078

Fourmile Creek site 977078 (Fig. 90) located near Southeast Oralabor Road northeast of the airport in Ankeny began monitoring in mid-July 2017. Three assessments were completed. The dissolved oxygen concentration reported in July was below normal but all other readings were normal (Fig. 94).

The IBI of 1.7 indicated this site has a poor benthic macroinvertebrate population present at this time.

Figure 91. Little Fourmile Creek Site 977321

Little Fourmile Creek Site 977321 (Fig. 91) is located near East University in Pleasant Hill. Monitoring began in mid-July with three assessments completed. One very high chloride result of 209 mg/L was reported in September 2017 (Fig. 95). All other results fell within the normal range.

A low number of species found during the July biological assessment resulted in the IBI of

2.00, which indicates a fair benthic macroinvertebrate population present.

Little Fourmile Creek Site 977324 (no photograph available) is located along the railroad in Altoona Lions Park. Monitoring began in July 2017 with five assessments completed. All results fell within the normal range except two low the dissolved oxygen concentration in August and September (Fig. 94).

Very few benthic macroinvertebrates of the BMI middle-quality group were found during the July biological assessment resulted in the IBI of 2.00, which indicates a fair benthic macroinvertebrate population present.

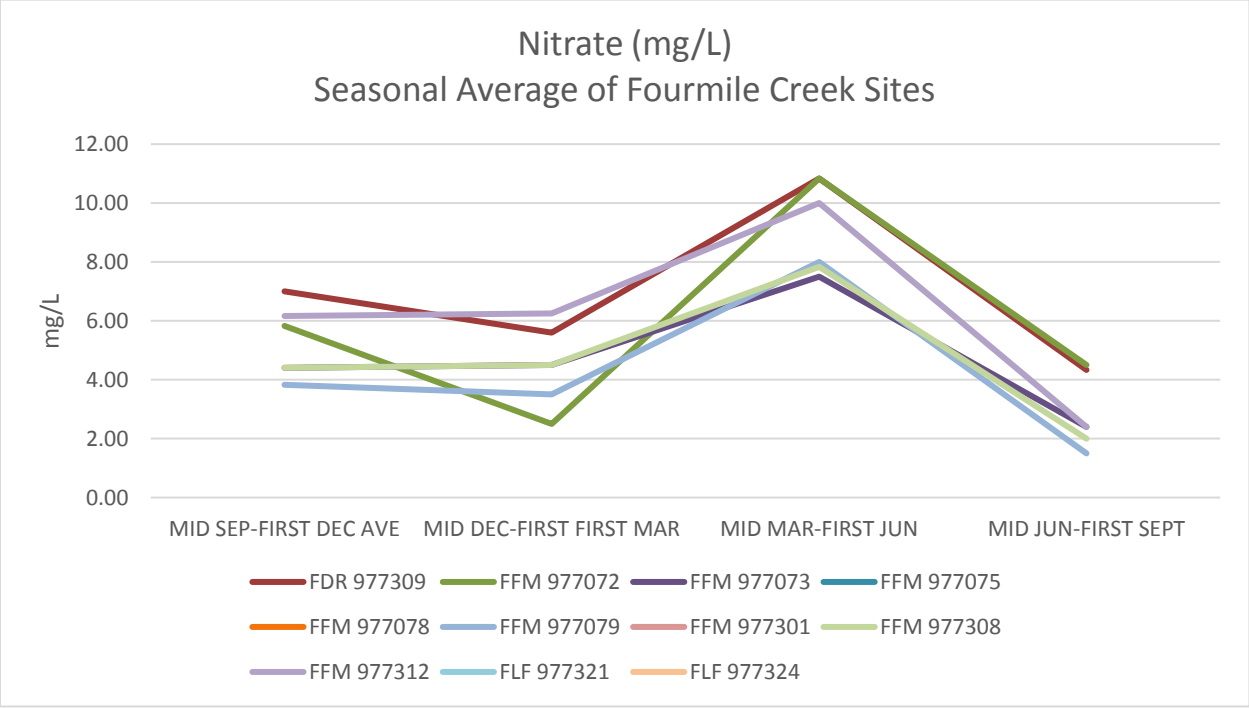

Figure 92. Seasonal Average Nitrate Concentrations for Fourmile Creek Sites Mid-September 2016 Through Mid-September 2017

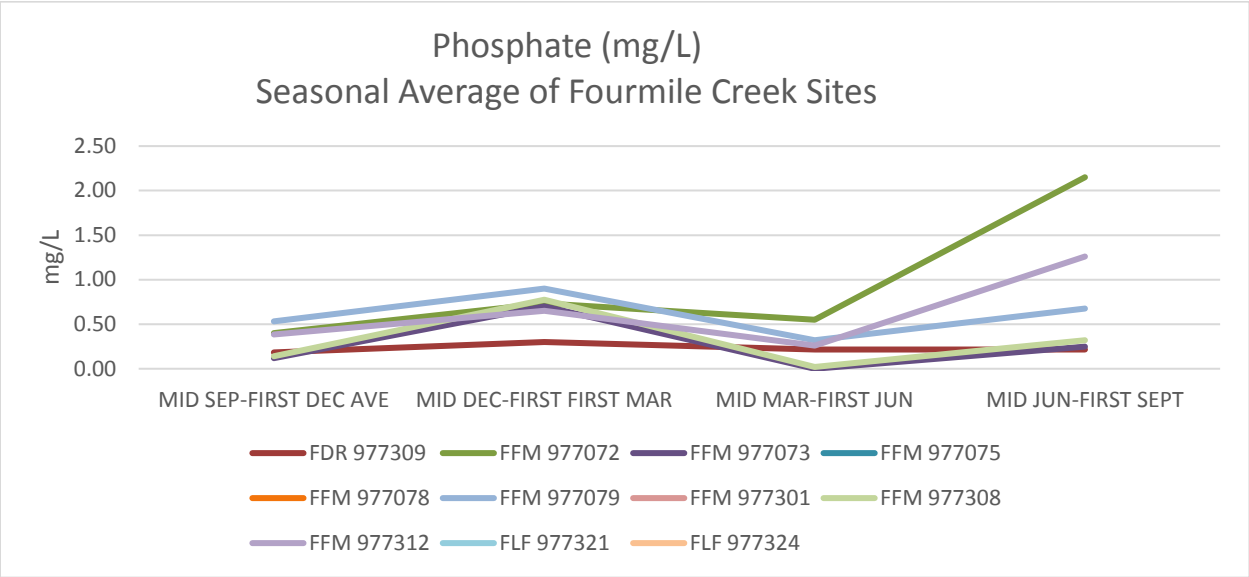

Figure 93. Seasonal Average Phosphate Concentrations for Fourmile Creek Sites Mid-September 2016 Through Mid-September 2017

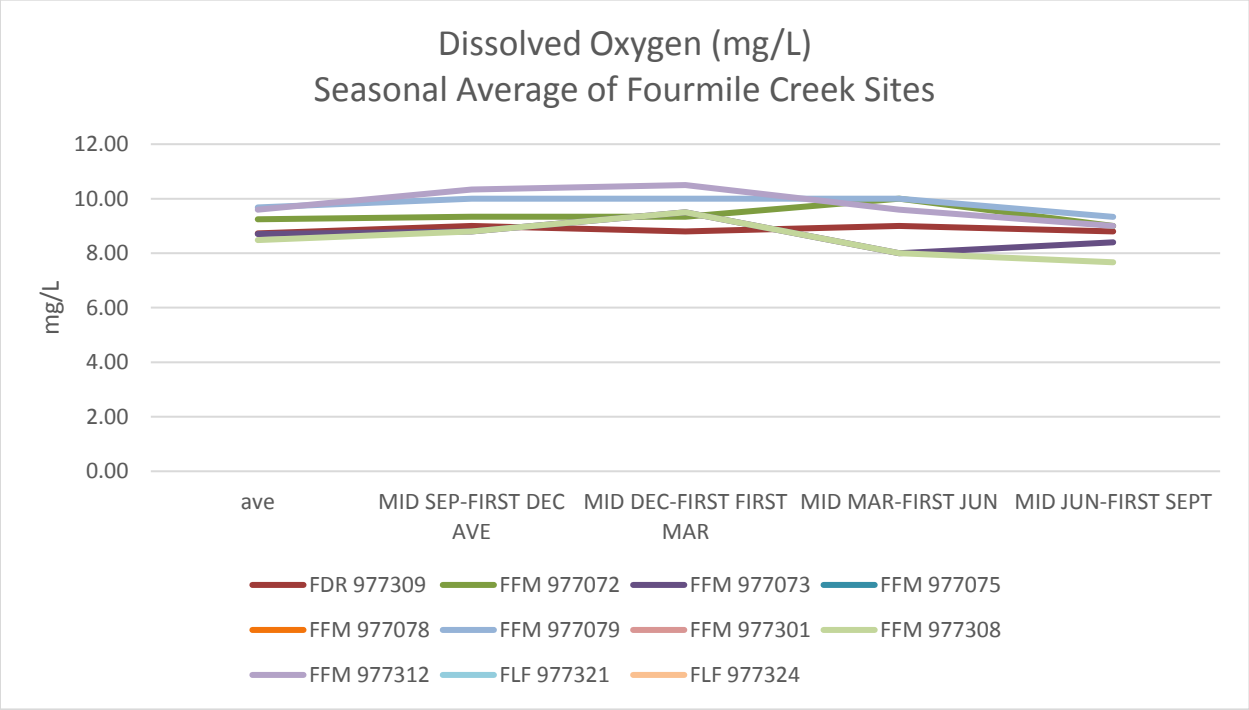

Figure 94. Seasonal Average Dissolved Oxygen Concentrations for Fourmile Creek Sites Mid-September 2016 Through Mid-September 2017

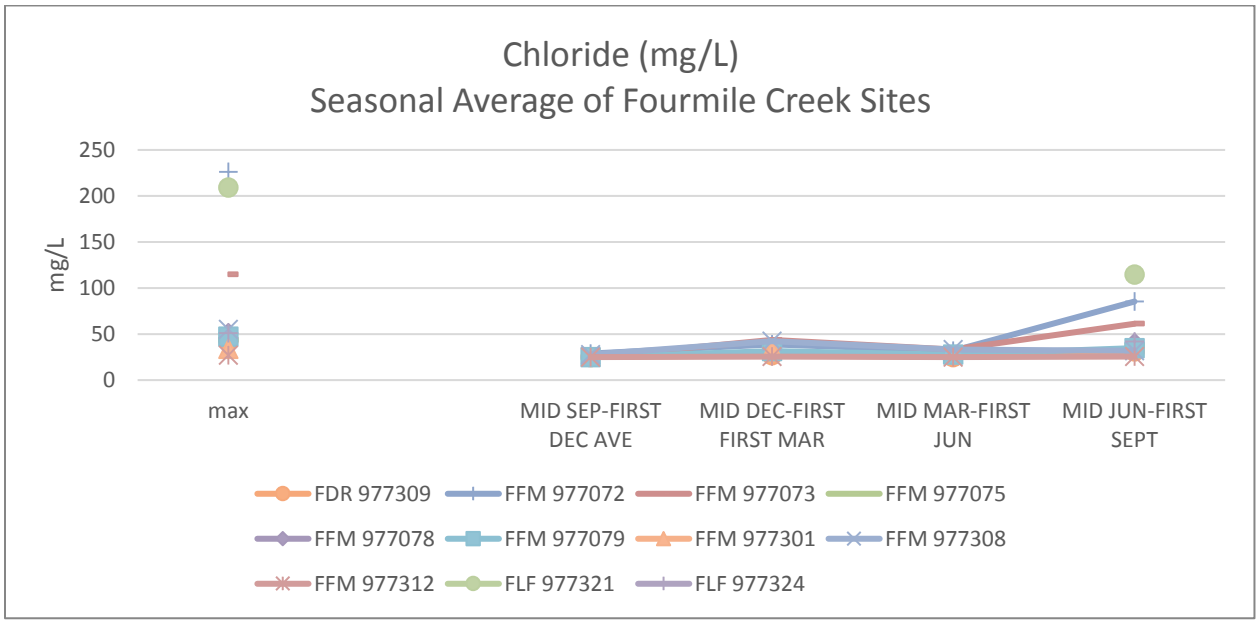

Figure 95. Seasonal Average Chloride Concentrations for Fourmile Creek Sites Mid-September 2016 Through Mid-September 2017

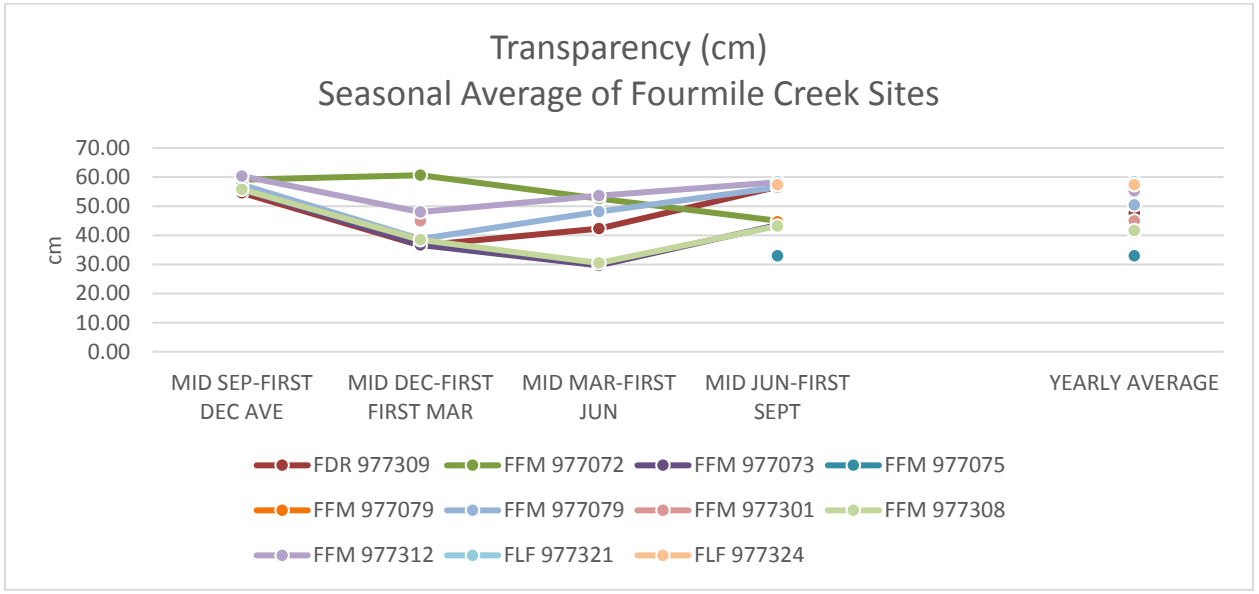

Figure 96. Seasonal Average Transparency for Fourmile Creek Sites Mid-September 2016 Through Mid-September 2017

Jordan Creek

Site Number	Creek Name	Site Name
JJR 977085	Jordan Creek	Polk County Snapshot (Site JC1 - Jordan Creek)
JJR 977270	Jordan Creek	Jordan Creek at Walking Trail Bridge
JJR 977029	Jordan Creek	Jordan Creek
JJR 977150	Jordan Creek	Jordan Creek 2 - Barker Lemar

Table 7. Jordan Creek Water Quality Monitoring Sites

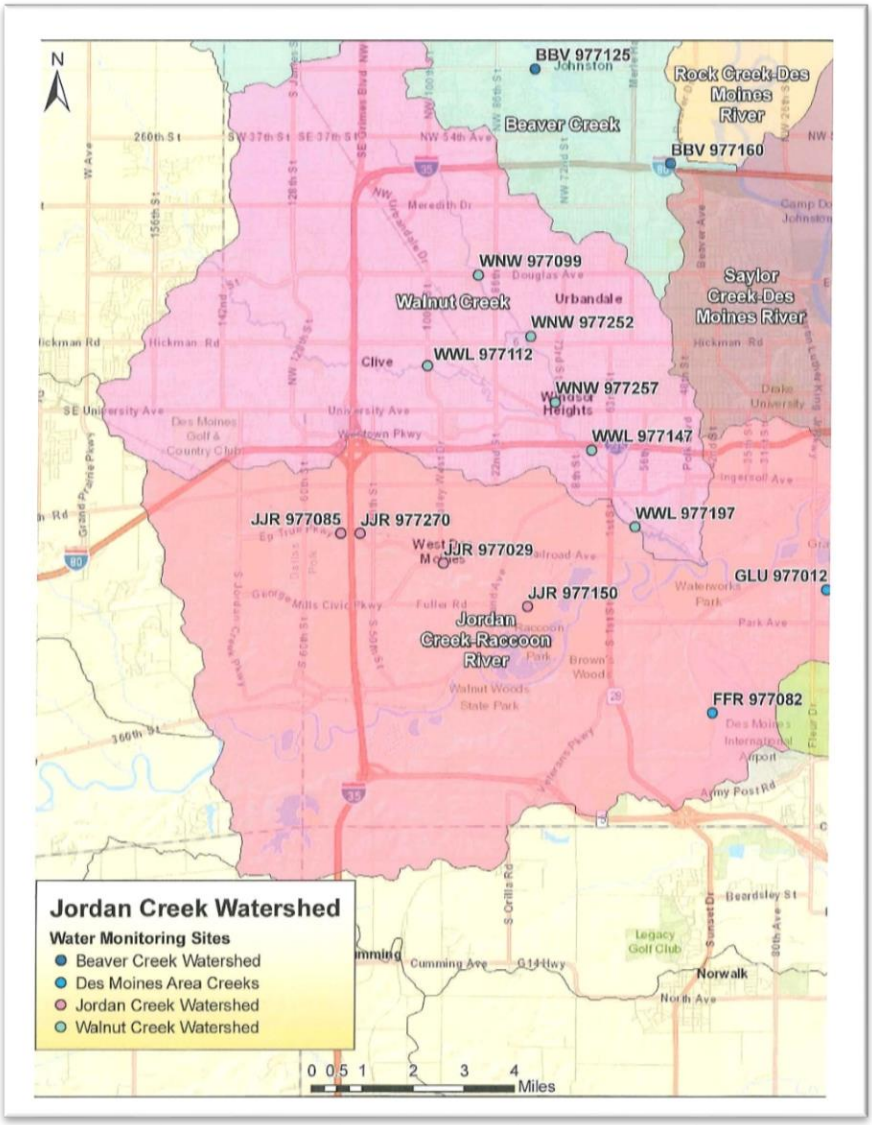

Figure 97. Jordan Creek Water Quality Monitoring Sites

Monitoring began on four sites along Jordan Creek in July 2017 (Fig. 97). Jordan Creek travels west to east through West Des Moines. No abnormal results were found from the July through September 2017 monitoring period.

Biological assessments indicating the present or absence of benthic macroinvertebrates were **completed; therefore, an IBI** was not calculated.

Jordan Creek Site 977085 (Fig. 98) is located along the Jordan Creek Trail east of Interstate 35. Monitoring began in mid-July 2017 with five completed assessments. No abnormal results were found.

The biological assessment was completed for this site in July 2017. Species in the high- and middle-quality groups were noted. Because the number of benthic macroinvertebrates was not recorded, an IBI could not be calculated for this site.

Figure 98. Jordan Creek Site 977085

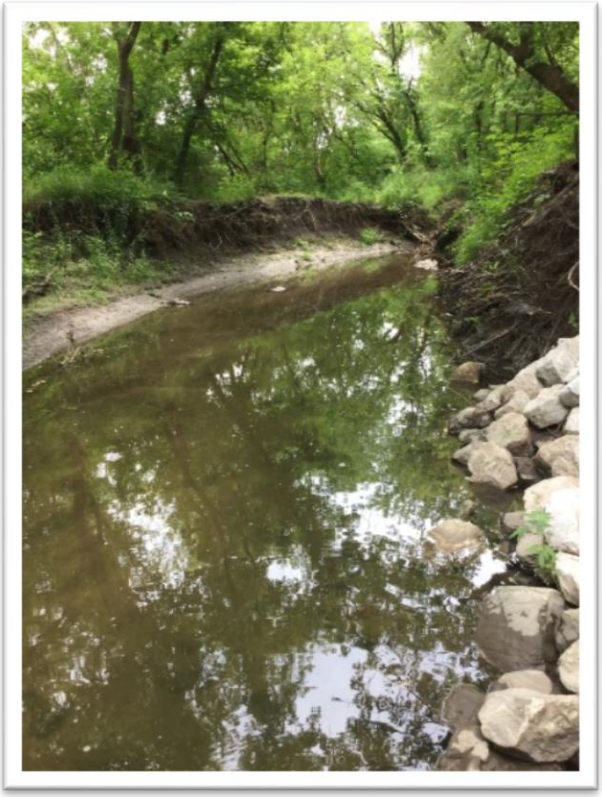

Figure 99. Jordan Creek Site 977270

Jordan Creek Site 977270 (Fig. 99) is located at Walking Trail Bridge north of E. P. True Parkway in West Des Moines east of Interstate 35. Monitoring began in mid-July 2017 with four completed assessments. One high chloride concentration of 104 mg/L was reported in July 2017 with remaining results normal (Fig. 106).

The biological assessment completed for this site in July 2017, resulted in only one high-quality benthic macroinvertebrate found so the IBI could not be calculated.

Jordan Creek Site 977029 (Fig. 100) is located near Mills Civic Parkway near the West Des Moines Police Department in West Des Moines. Monitoring began in mid-July 2017 with five completed assessments. No abnormal results were found.

The biological assessment was completed for this site in July 2017. No benthic macroinvertebrates were collected.

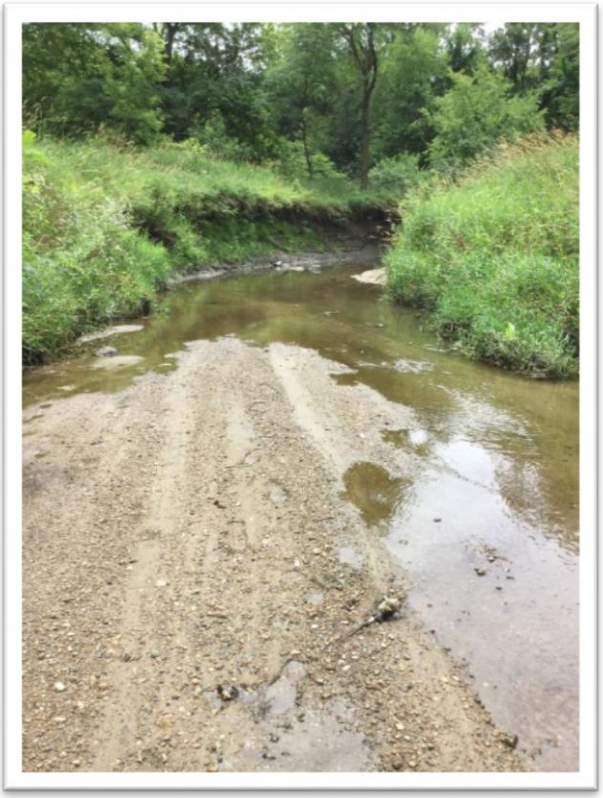

Figure 100. Jordan Creek Site 977029

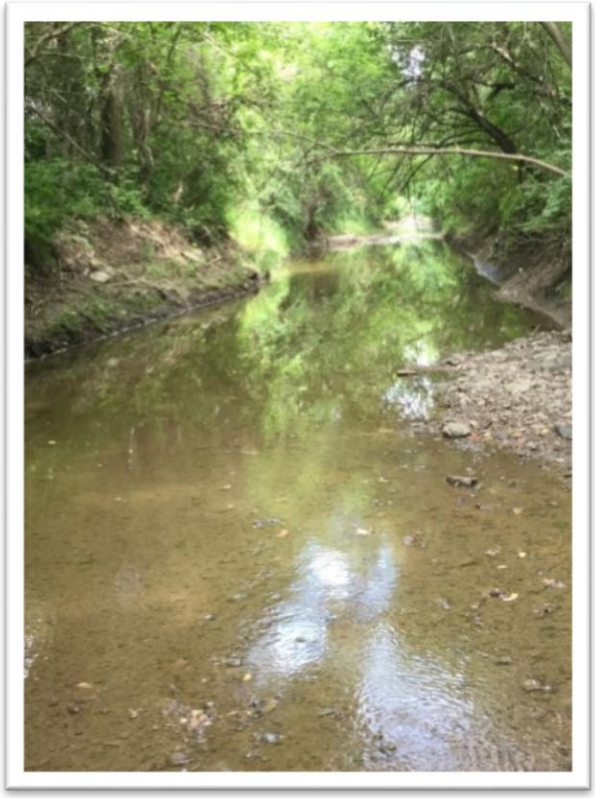

Figure 101. Jordan Creek Site 977150

Jordan Creek Site 977150 (Fig. 101) is located in Raccoon River Park along the Jordan Creek Trail in West Des Moines. Monitoring began in mid-July 2017 with five completed assessments. No abnormal results were found.

The biological assessment completed for this site in July 2017 found no benthic macroinvertebrates.

Figure 102. Erosion Along Jordan Creek Site 977150

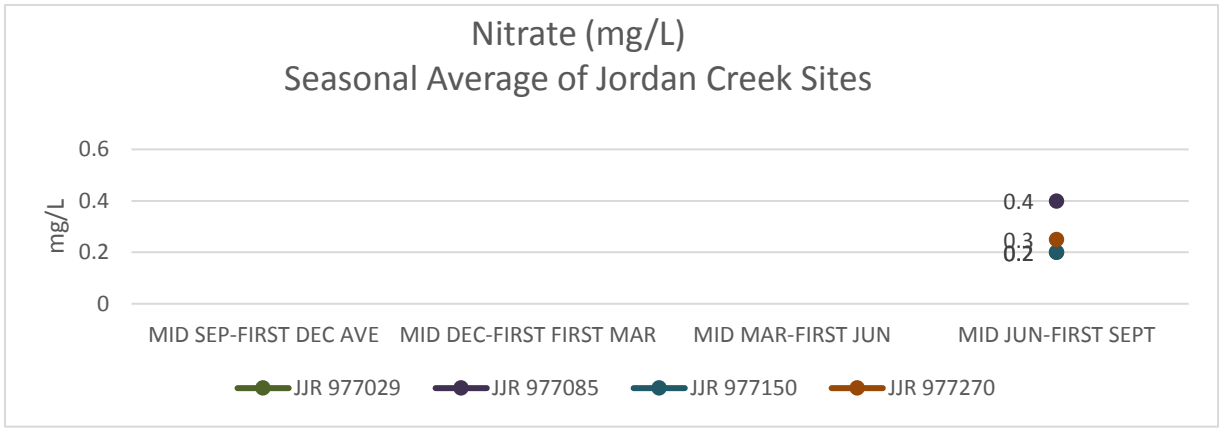

Figure 103. Seasonal Average Nitrate Concentrations for Jordan Creek Sites Mid-September 2016 Through Mid-September 2017

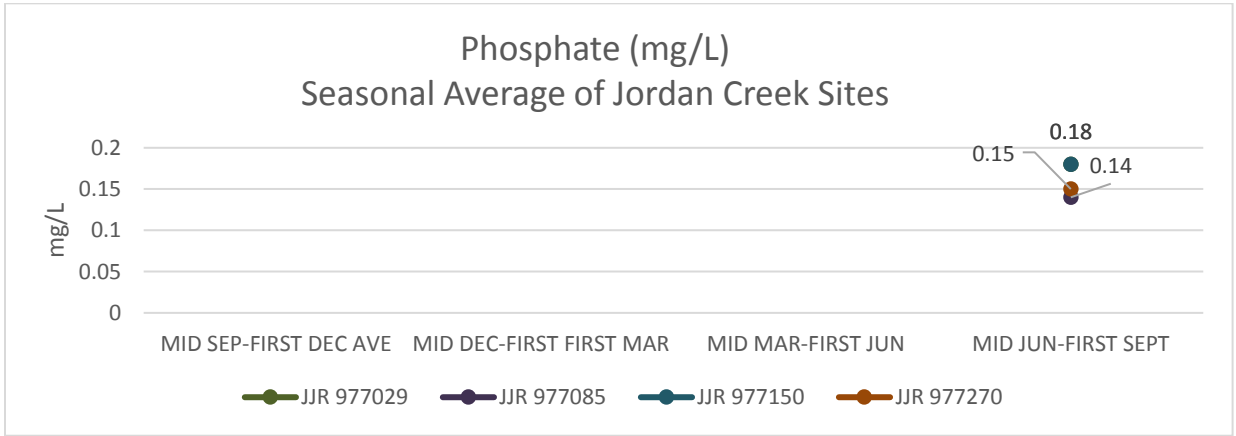

Figure 104. Seasonal Average Phosphate Concentrations for Jordan Creek Sites Mid-September 2016 - Mid-September 2017

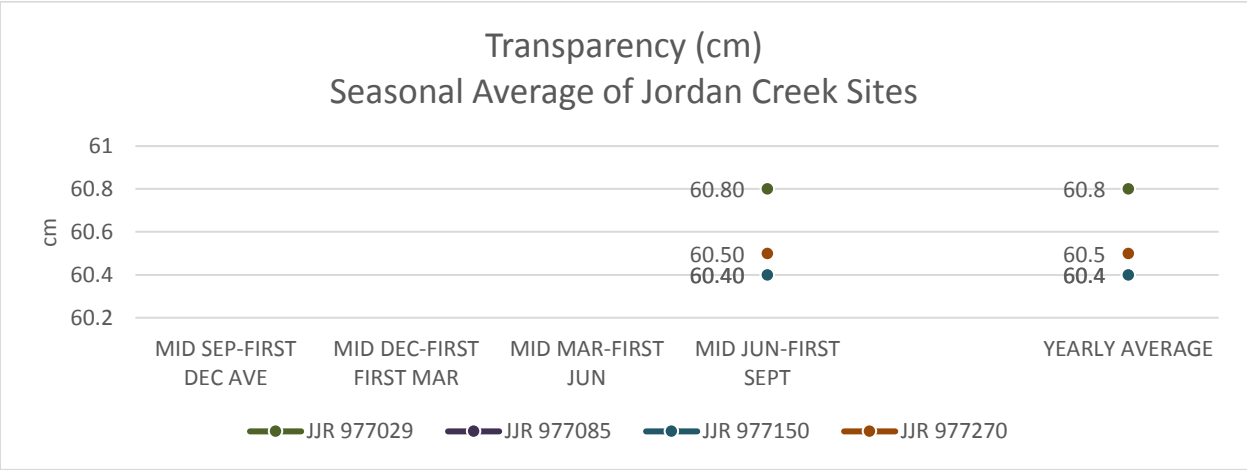

Figure 105. Seasonal Average Transparency for Jordan Creek Sites Mid-September 2016 Through Mid-September 2017

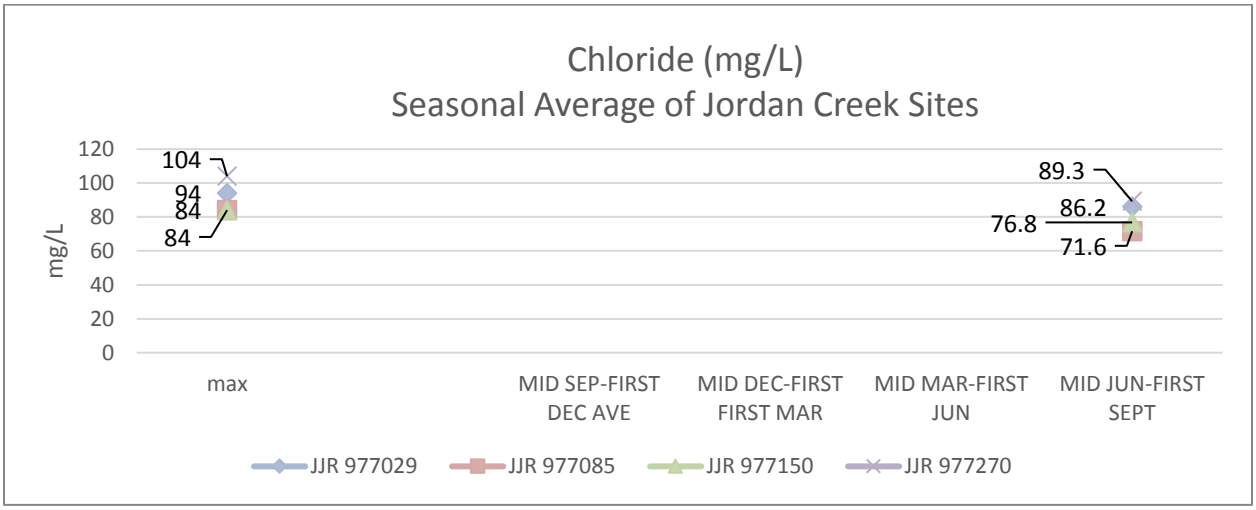

Figure 106. Seasonal Average Chloride Concentrations for Jordan Creek Sites Mid-September 2016 Through Mid-September 2017

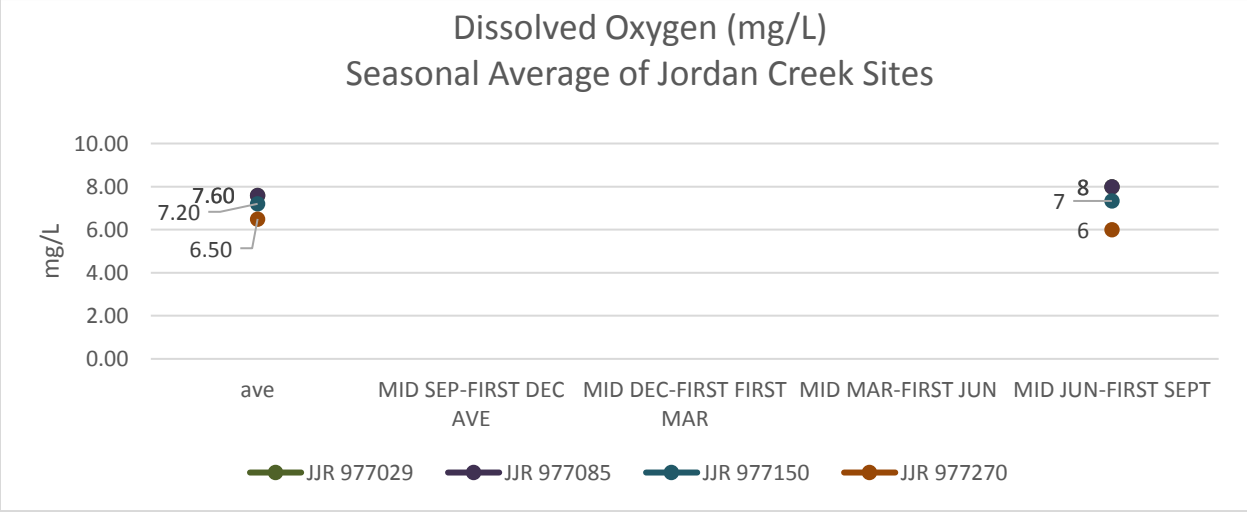

Figure 107. Seasonal Average Dissolved Oxygen Concentrations for Jordan Creek Sites Mid-September 2016 Through Mid-September 2017

Paw Creek

Site Number	Creek Name	Site Name
JPW 977300	Jester Park - Paw Creek	Paw Creek
JPW 977313	Jester Park - Paw Creek	Paw Creek-Golf Course Fork

Table 8. Paw Creek Water Quality Monitoring Sites

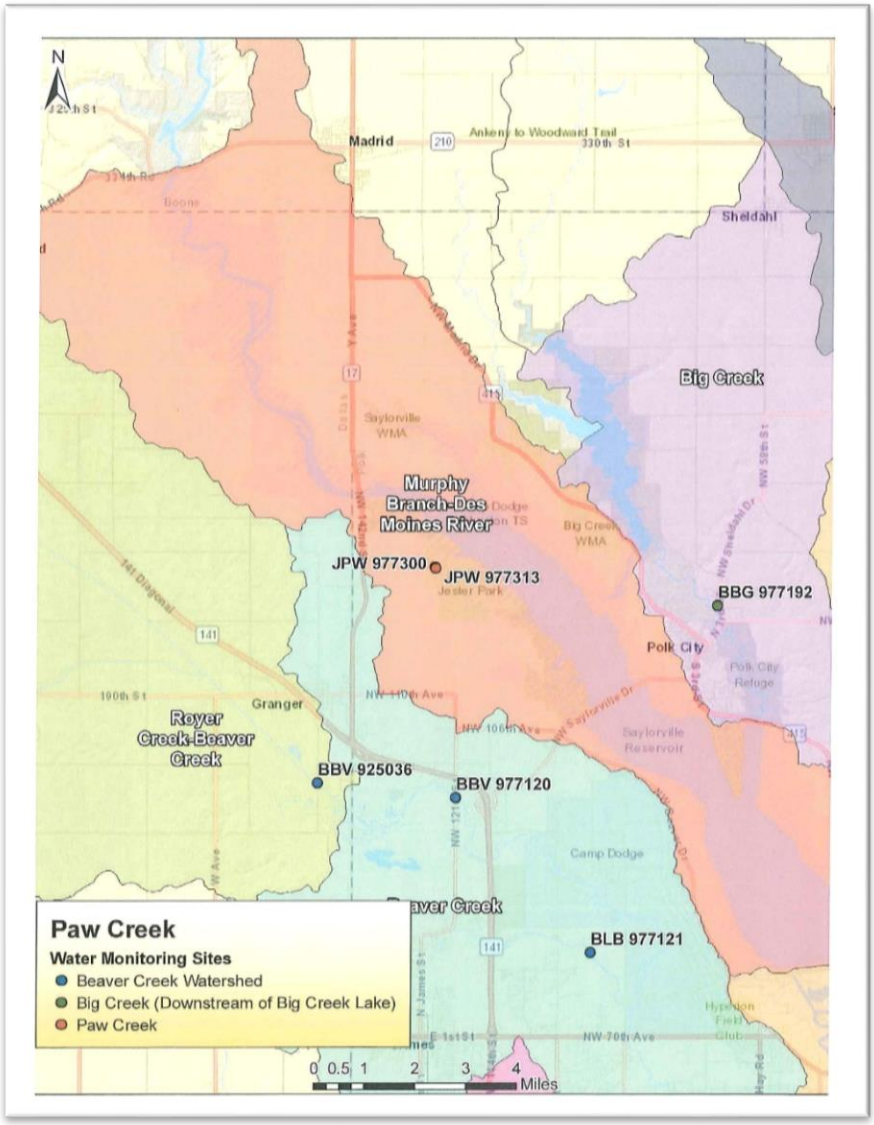

Figure 108. Water Quality Monitoring at Paw Creek

Paw Creek is located in Lewis A. Jester Park. The watershed is small and made up largely of parkland and rural area with a small housing development adjacent to the park. Two sites along Paw Creek in Jester Park were monitored. Site 977300 is located near the footbridge along Timber Ridge Trail. The second, site 977313, includes the golf course tributary, which enters Paw Creek just downstream from site 977300.

Chemical/physical assessments were completed throughout the year except when frozen in winter 2016-2017 and dry in late summer 2017. Results were similar at

both sites. Nitrate concentrations were in the normal range for both creek branches, but were slightly lower in the tributary from the golf course (Fig. 109). Phosphate concentrations were normal for all but one assessment on site 977300 (Fig. 110). All other parameters were within the normal range (Figs. 111-113).

Biological assessments were completed for both sites. Benthic macroinvertebrate species were marked as present or absent but not counted so an IBI was not calculated. The tributary from the golf course site 977313 found benthic macroinvertebrates in each of the groups. The main tributary creek site 977300 had specimens from the BMI middle-quality and low-quality groups may indicating some degree of pollution or habitat degradation in this area, however, the area is safe to use for recreation.

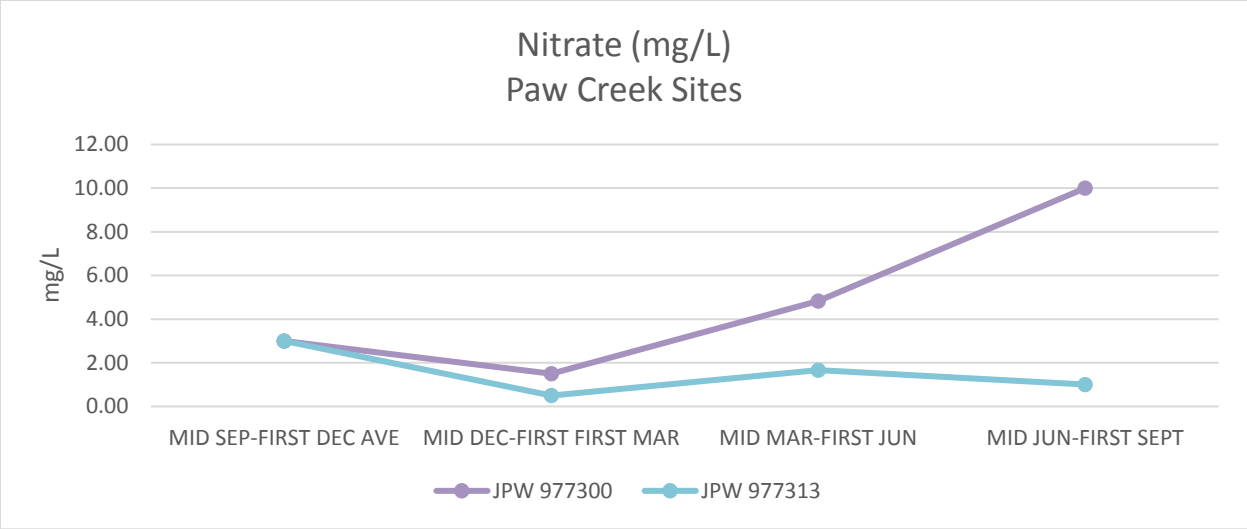

Figure 109. Seasonal Average Nitrate Concentrations for Paw Creek Sites Mid-September 2016 Through Mid-September 2017

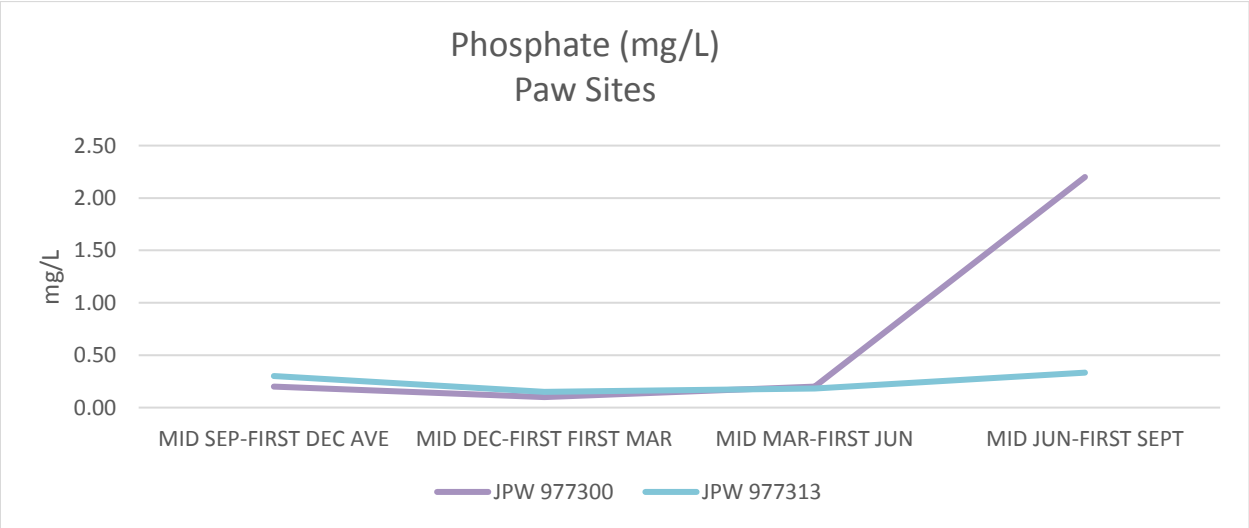

Figure 110. Seasonal Average Phosphate Concentrations for Paw Creek Sites Mid-September 2016 Through Mid-September 2017

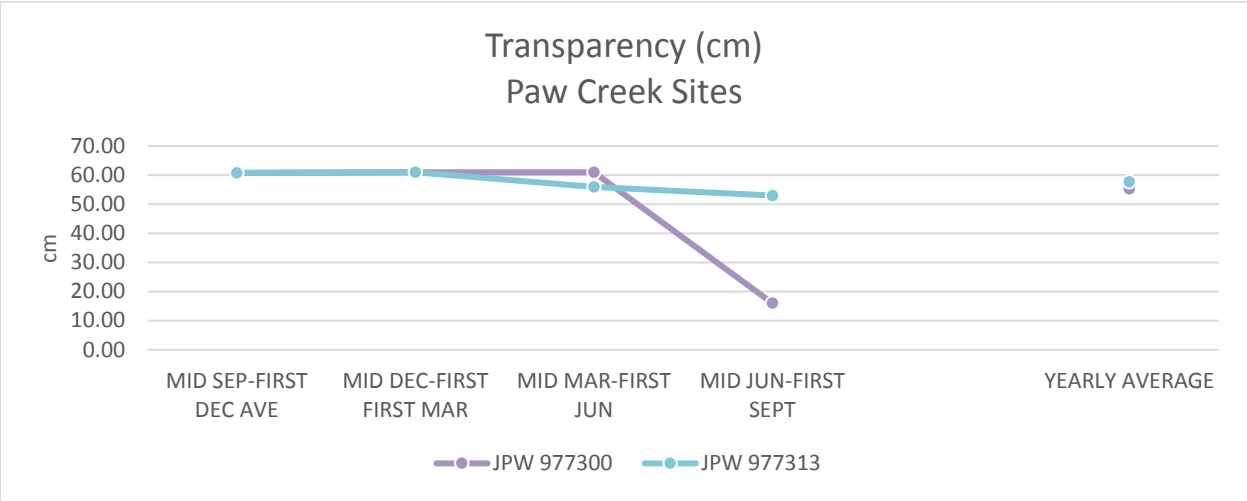

Figure 111. Seasonal Average Transparency for Paw Creek Sites Mid-September 2016 Through Mid-September 2017

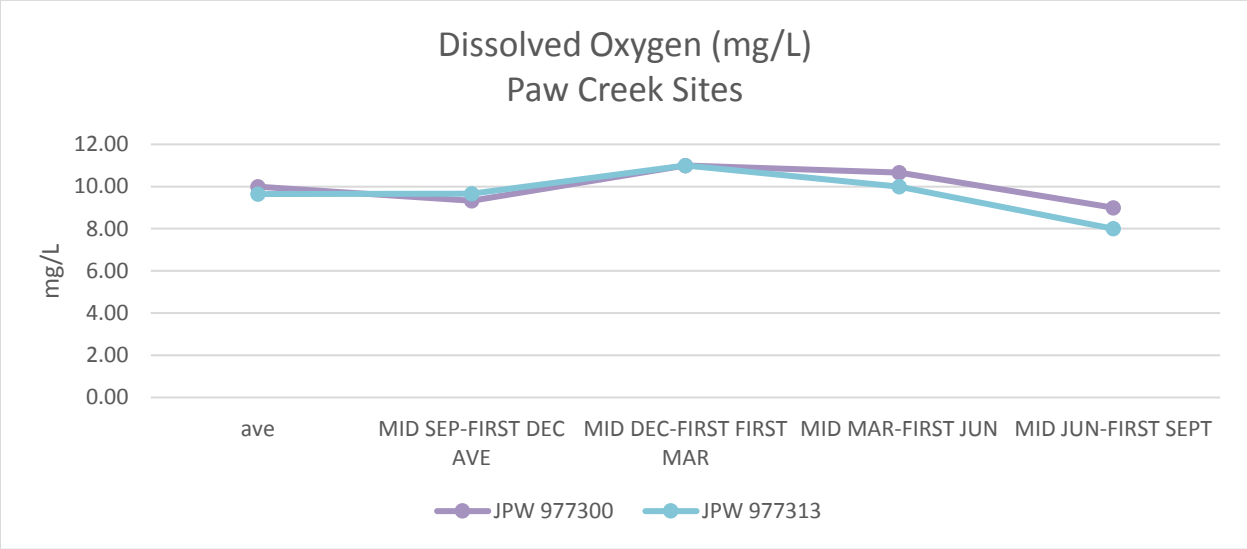

Figure 112. Seasonal Average Dissolved Oxygen Concentrations for Paw Creek Sites Mid-September 2016 Through Mid-September 2017

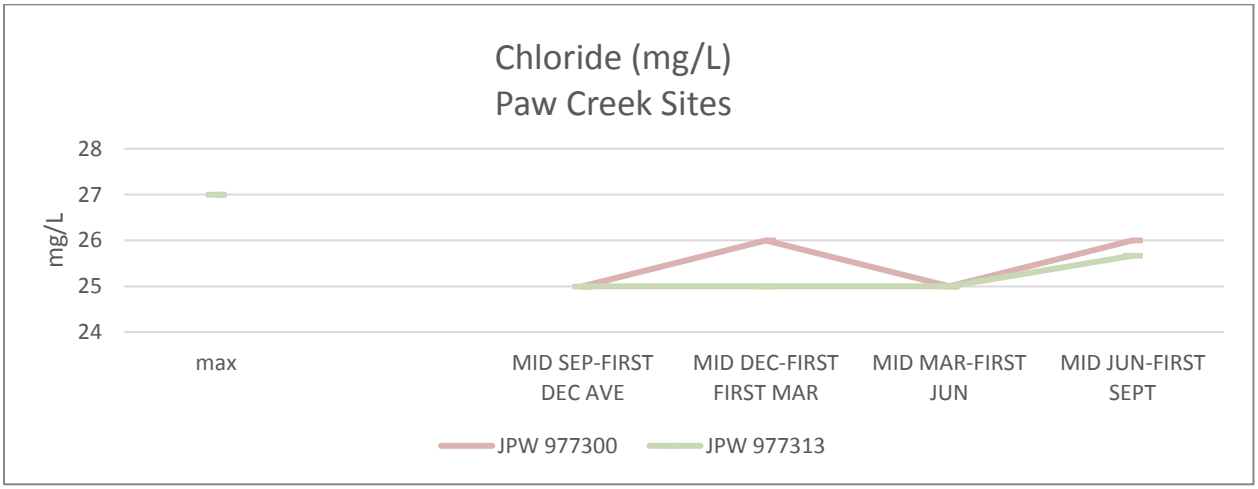

Figure 113. Seasonal Average Chloride Concentrations for Paw Creek Sites Mid-September 2016 Through Mid-September 2017

Rock Creek Watershed

Site Number	Creek Name	Site Name
RRO 977196	Rock Creek	Ankeny-Woodward Bike Trail & Rock Creek
RRC 977104	Rock Creek	Polk County Snapshot (Site RC1 - Rock Creek)
RRC 977105	Rock Creek	Polk County Snapshot (Site RC2 - Rock Creek)

Table 9. Rock Creek Water Quality Monitoring Sites

Figure 114. Rock Creek Water Quality Monitoring Sites

Rock Creek is located in Ankeny east of Saylorville Lake (Fig. 114). The watershed begins near the High Trestle (Ankeny – Woodward) Trail located in northern Ankeny along agricultural land. The creek travels south through suburban residential area along Ankeny Golf and Country Club until it reaches the Saylorville Lake outlet channel of the Des Moines River.

Figure 115. Rock Creek Site 977104

Figure 116. Rock Creek Site 977105

Monitoring began on three sites along Rock Creek in July 2017. Site 977196 (no photograph available), located on the High Trestle Trail and site 977104 (Fig. 115), approximately 0.5 miles downstream along NW 18th Street, are surrounded by agricultural land. Site 977105 (Fig. 116), located two miles south on Northwest Polk City Drive, is south of Ankeny Golf and Country Club.

Assessments results were normal throughout the year until late summer when high nitrate concentrations were reported and dissolved oxygen concentrations dropped in the sites near agricultural land (Figs. 117 & 120).

The biological assessments were completed for all three sites however, few benthic macroinvertebrates were found. Site 977196 did not find any species, sites 977105 and 977105 reported species from the BMI middle-quality and low-quality groups indicating a poor benthic macroinvertebrate population.

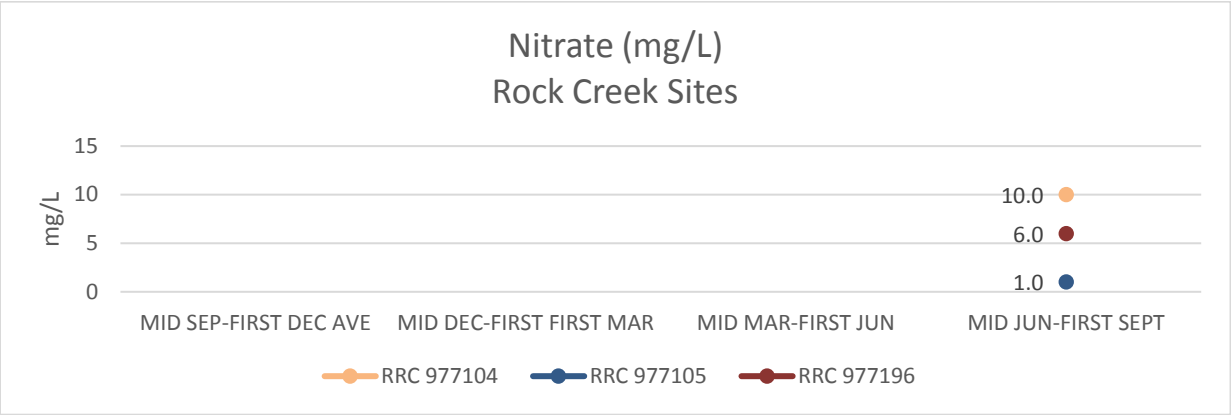

Figure 117. Seasonal Average Nitrate Concentrations for Rock Creek Sites Mid-September 2016 Through Mid-September 2017

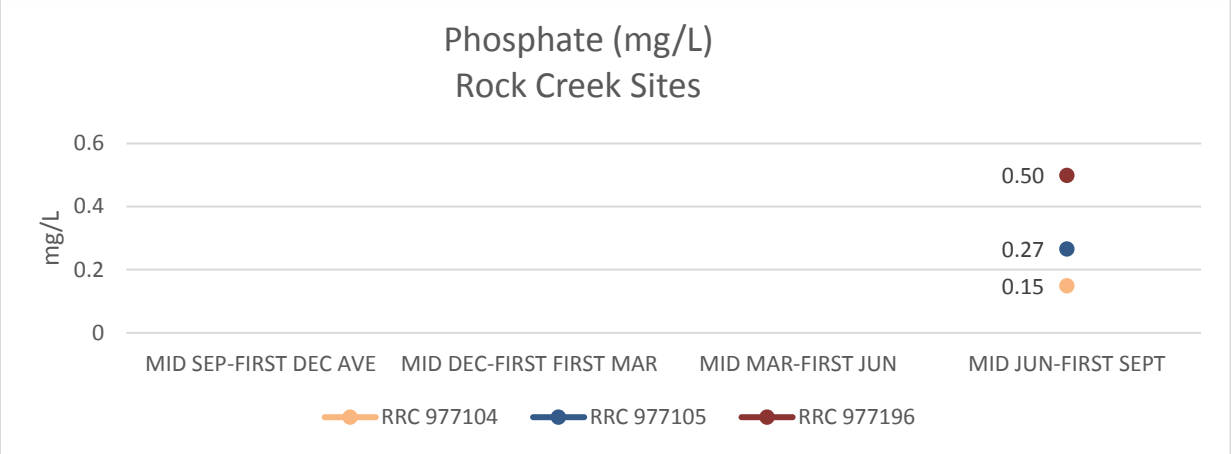

Figure 118. Seasonal Average Phosphate Concentrations for Rock Creek Sites Mid-September 2016 Through Mid-September 2017

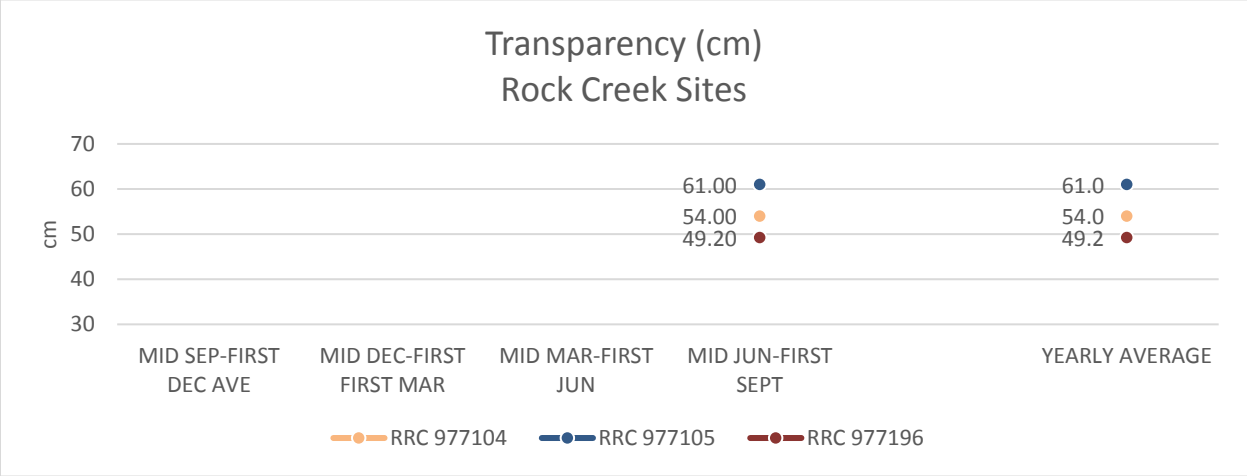

Figure 119. Seasonal Average Transparency for Rock Creek Sites Mid-September 2016 Through Mid-September 2017

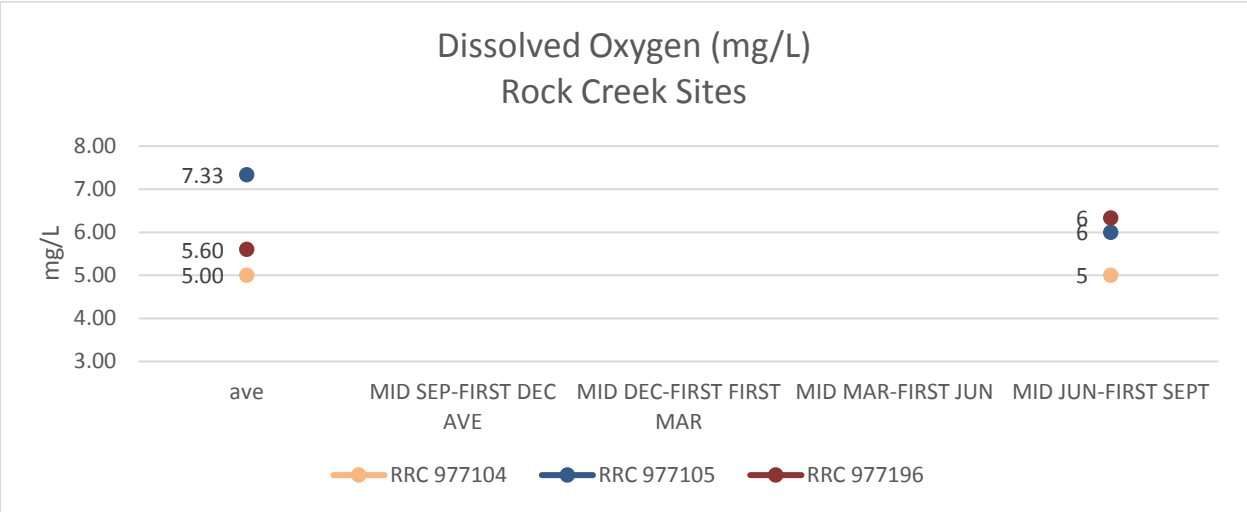

Figure 120. Seasonal Average Dissolved Oxygen for Rock Creek Sites Mid-September 2016 Through Mid-September 2017

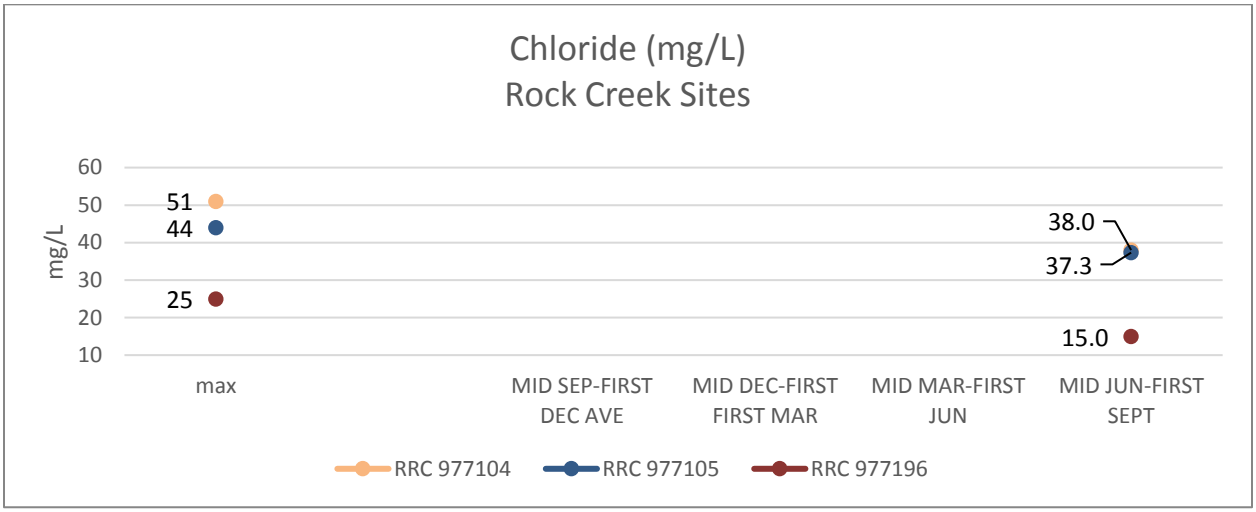

Figure 121. Seasonal Average Chloride Concentrations for Rock Creek Sites Mid-September 2016 Through Mid-September 2017

Saylor Creek Watershed

Site Number	Creek Name	Site Description
SSY 977189	Saylor Creek	N of Prairie Trail At Magazine
SSY 977106	Saylor Creek	Polk County Snapshot (Site Saylor Creek)

Table 10. Saylor Creek Water Quality Monitoring Sites

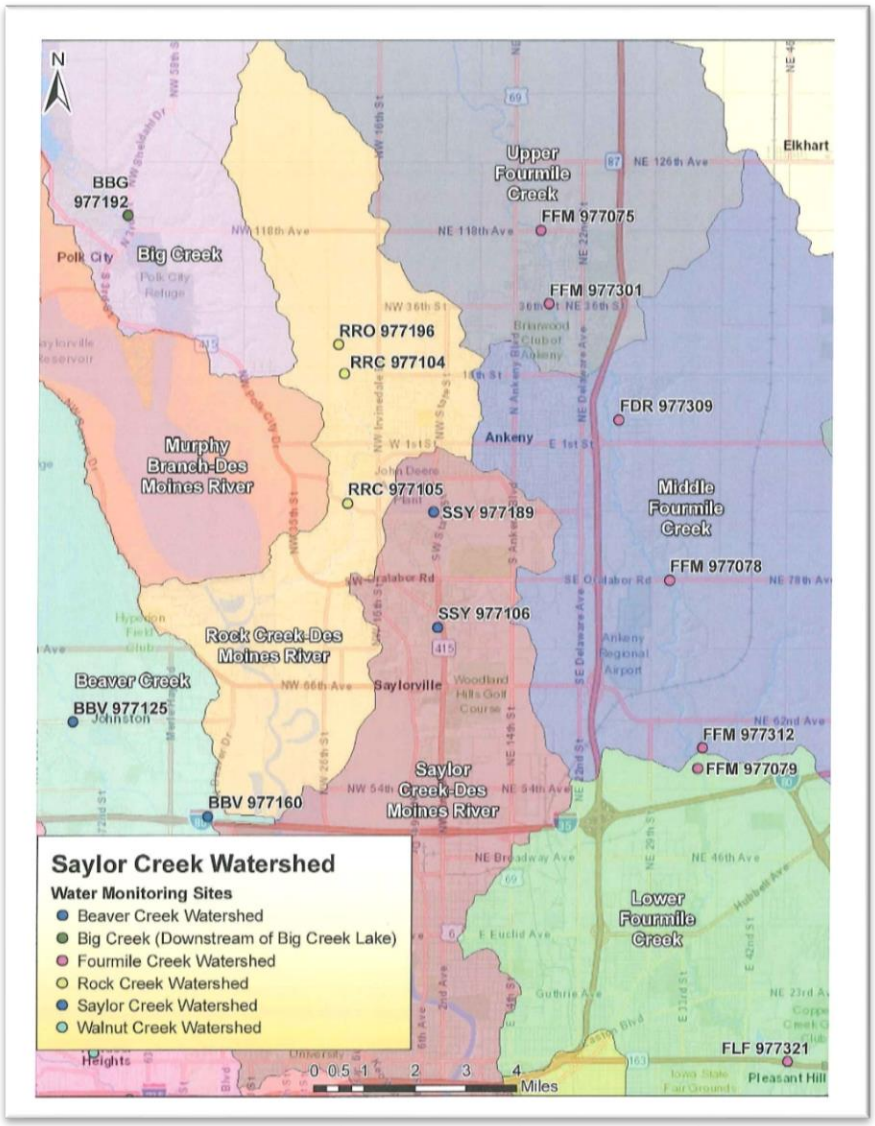

Figure 122. Saylor Creek Water Quality Monitoring Sites

Saylor Creek flows from the central Ankeny near John Deere and the DMACC campus south to the Des Moines River (Fig. 122). Two sites along Saylor Creek were added to the PCCWQMP in July 2017. Site 977189 is located north of Prairie Trail west of Southwest State Street. Site 977106 is located approximately 1.75 miles downstream west of Southwest State Street along Northwest 72nd Place in Ankeny.

Figure 123. Saylor Creek Site 977189

Figure 124. Saylor Creek Site 977106

Saylor Creek Site 977189 (Fig. 123) experienced both low dissolved oxygen and high chloride readings in July and August prior to drying up in September (Figs. 128 & 129). Downstream, site 977106 (Fig. 124) did not report any abnormal readings.

The biological assessments were completed for the two Saylor Creek sites in July 2017. Benthic macroinvertebrates were found in BMI middle-quality and low-quality groups. The calculated IBI for site 977189 was 1.25 and for Site 977106 was 1.2, indicating a poor benthic macroinvertebrate community for both sites.

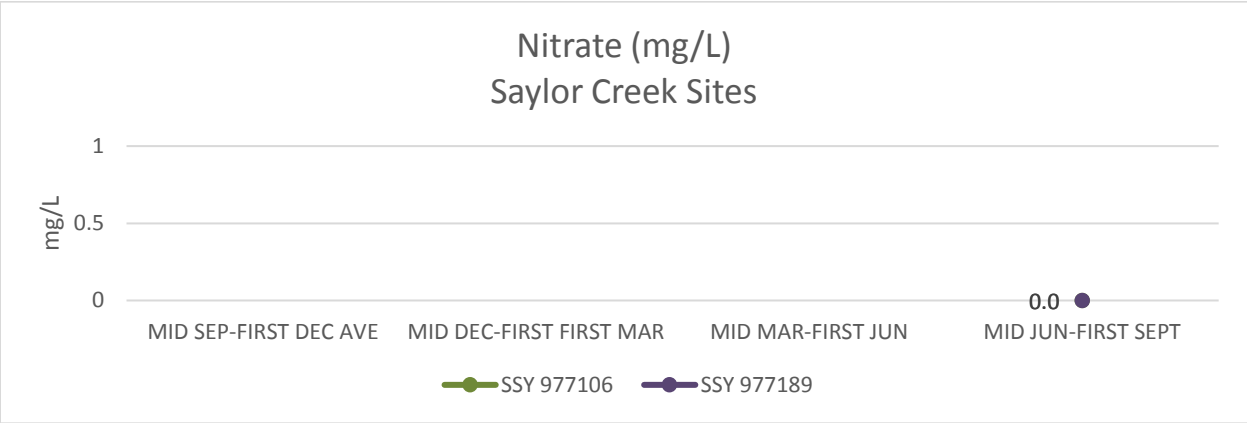

Figure 125. Seasonal Average Nitrate Concentrations for Saylor Creek Sites Mid-September 2016 Through Mid-September 2017

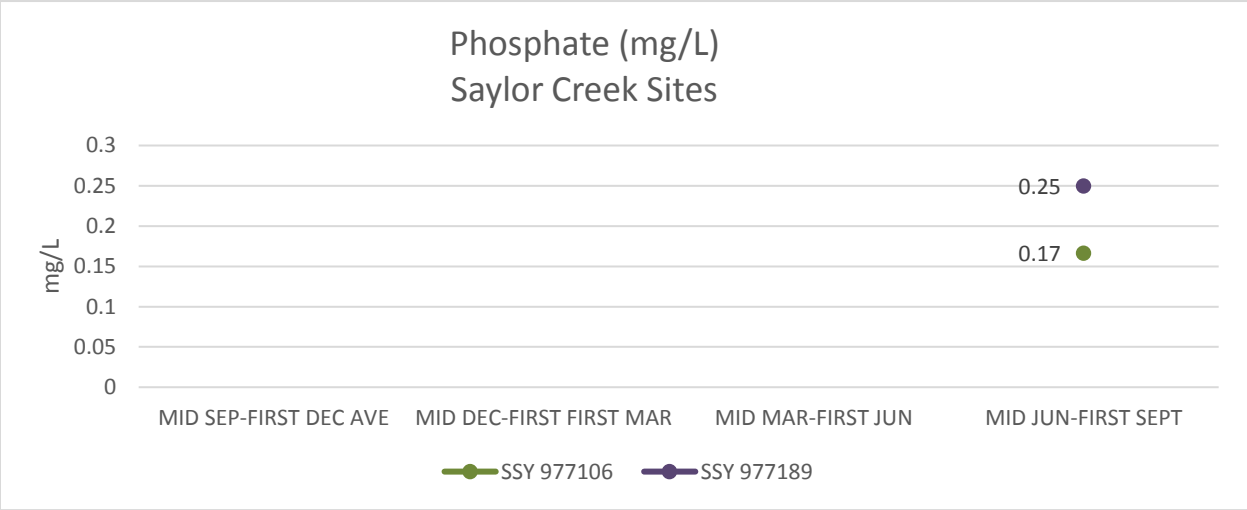

Figure 126. Seasonal Average Phosphate Concentrations for Saylor Creek Sites Mid-September 2016 Through Mid-September 2017

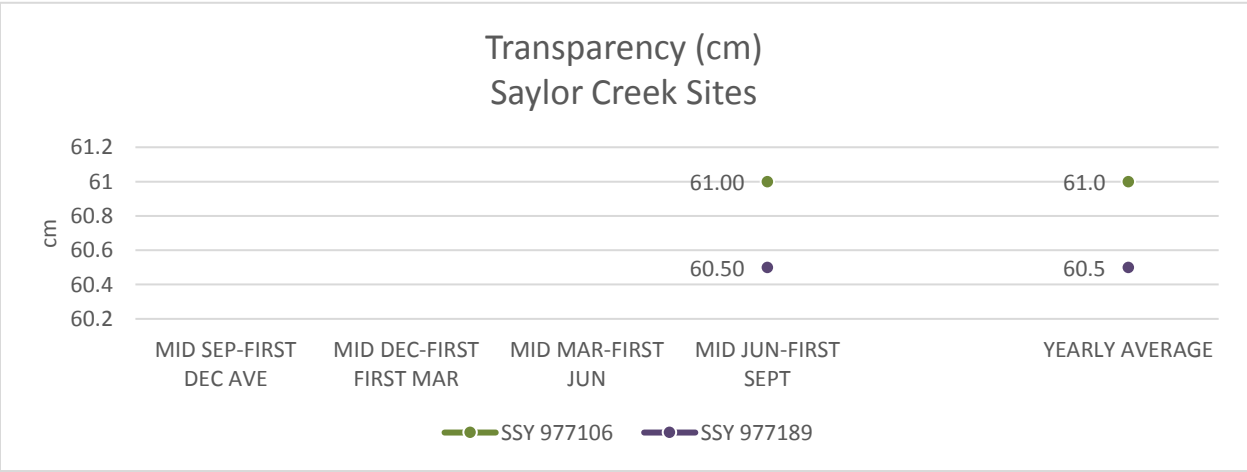

Figure 127. Seasonal Average Transparency for Saylor Creek Sites Mid-September 2016 Through Mid-September 2017

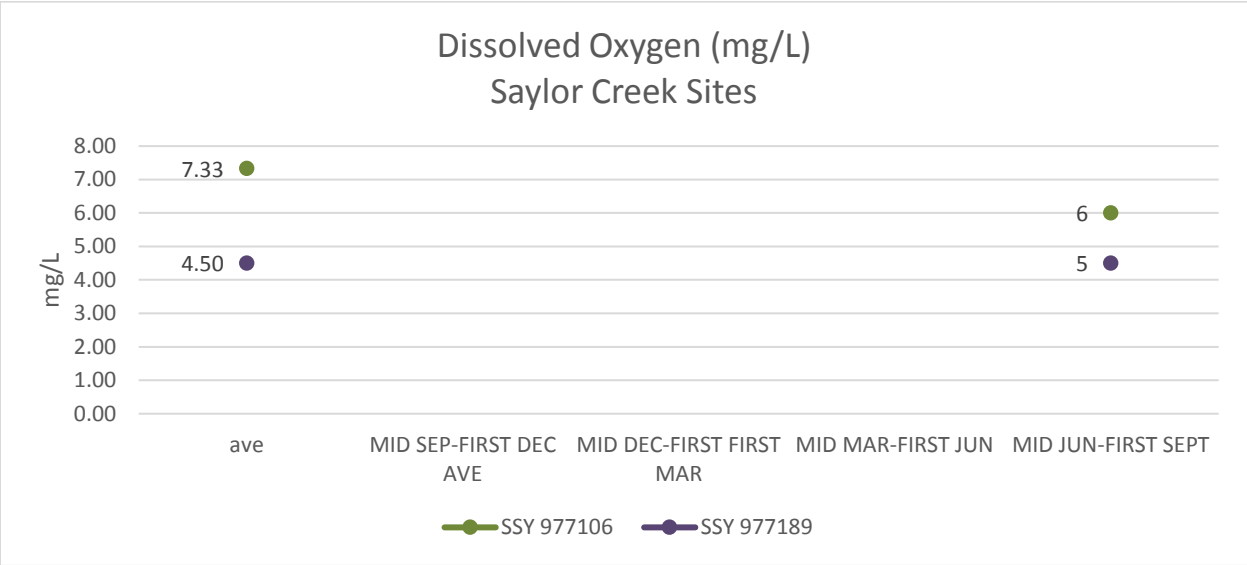

Figure 128. Seasonal Average Dissolved Oxygen Concentrations for Saylor Creek Sites Mid-September 2016 Through Mid-September 2017

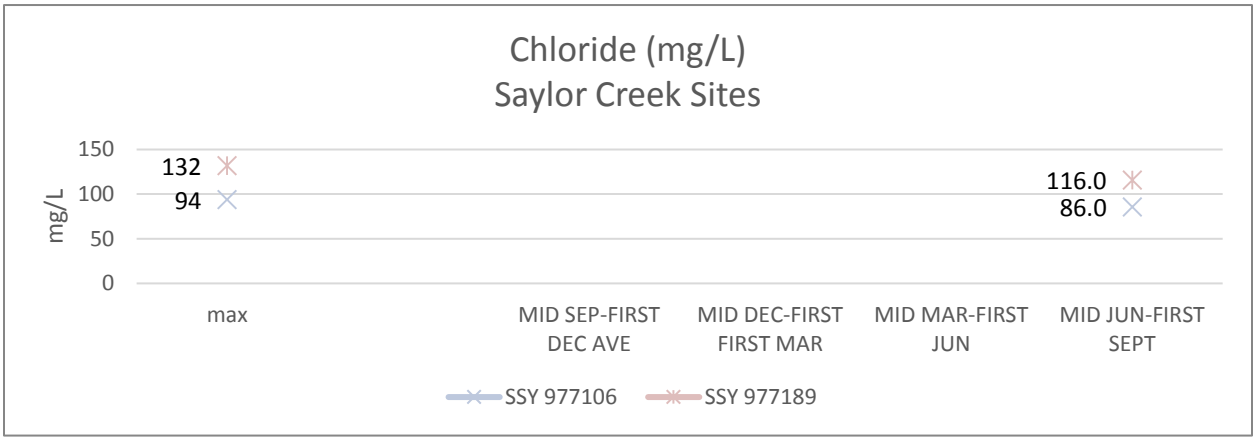

Figure 129. Seasonal Average Chloride Concentrations for Saylor Creek Sites Mid-September 2016 Through Mid-September 2017

Walnut Creek Watershed

Site Number	Creek Name	Site Description
WNW 977252	N Walnut Creek	North Walnut Creek Downstream of Tributary, North of Hickman Rd
WNW 977257	N Walnut Creek	North Walnut Creek DS of Trib (Storm Sewer), N of Univ. Blvd.
WWL 977099	Walnut Creek	Polk County Snapshot (Site NWC3 - North Walnut Creek)
WWL 977112	Walnut Creek	Polk County Snapshot (Site WC3 - Walnut Creek)
WWL 977147	Walnut Creek	Walnut Creek at Colby Park
WWL 977197	Walnut Creek	Walnut Creek at North Valley Drive

Table 11. Walnut Creek Water Quality Monitoring Sites

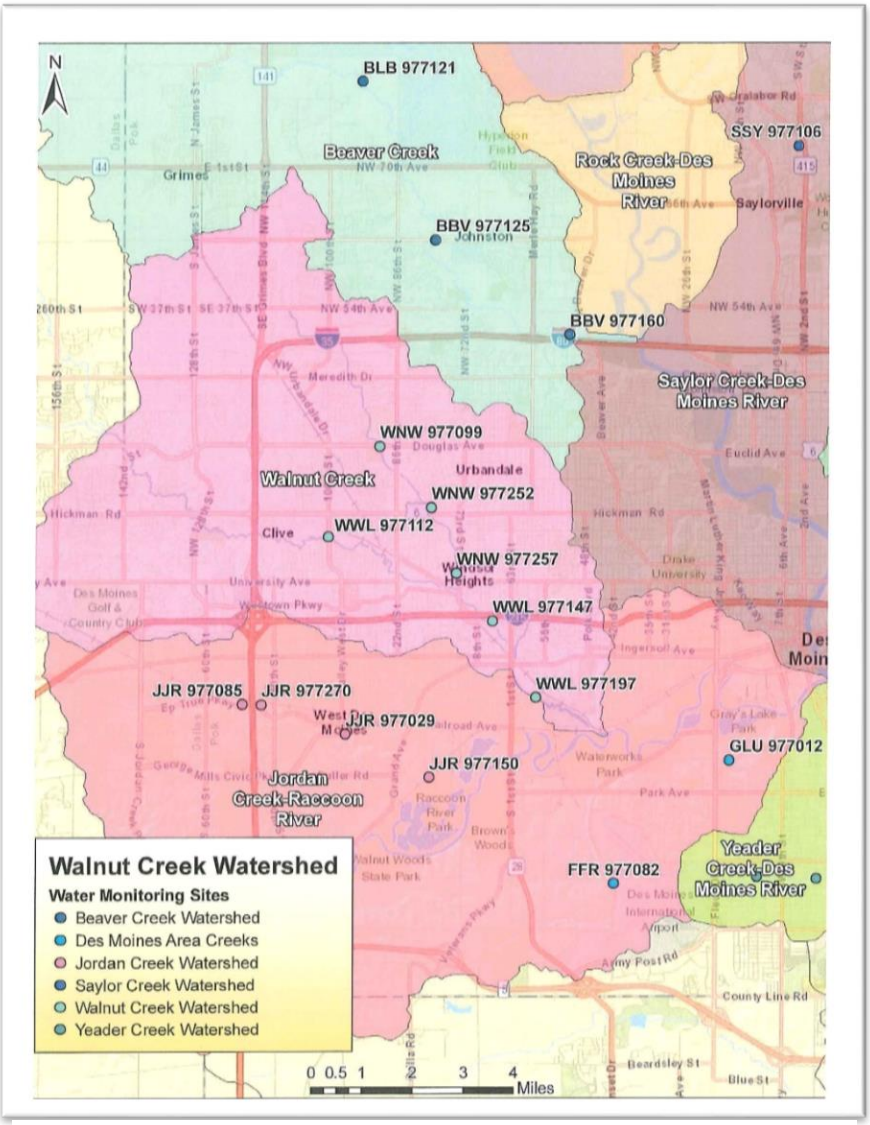

Figure 130. Walnut Creek Water Quality Monitoring Sites

The Walnut Creek watershed consists of over 83 square miles or more than 53,000 acres. Roughly, one-half of this area is developed and includes portions of the communities of Des Moines, Clive, Dallas Center, Grimes, Johnston, Urbandale, Waukee, West Des Moines and Windsor Heights. This area continues to change rapidly. As an example, over six square miles or more than 8% of the watershed land was developed from 2001-2011. This watershed is a source for metro drinking water.

Three water monitoring sites are located along Walnut Creek with three additional sites located along North Walnut Creek (Fig. 130). Four sites were monitored for the entire year. Monitoring on the other two sites began in May 2017.

Figure 131. North Walnut Creek Monitoring Site 977099

North Walnut Creek Site 977099, (Fig. 131) is located along the trail at Walker Johnson Park in Urbandale. This site had high phosphate, high chloride and low pH readings in January (Figs. 136 & 138). The high chloride concentrations continued through March with the maximum reading of 300 mg/L reported in mid-March. Chloride levels were consistently higher than for all other Walnut Creek sites monitored during this period (Fig. 138). This location has direct runoff from a road, a paved trail and Walker Johnson Park parking lot so the salt-laden runoff could explain the high winter and spring chloride levels. High summer chloride levels may be the result of fertilizers, human or animal waste present in the stream. Normal chloride readings were reported for the rest of the year. Dissolved oxygen and nitrate concentrations remained normal throughout the year at this site (Figs. 135 & 137).

A biological assessment was completed in July 2017. The presence of one benthic macroinvertebrate from the BMI high-quality, ten from the BMI middle-quality and three in the low-quality groups were found resulted in an IBI of 1.86. This indicates a fair benthic macroinvertebrate community present.

North Walnut Creek Site 977252 (photograph not available) is located north of Hickman Road west of Colby Woods Drive. Monitoring began on this site in May 2017. No abnormal readings were reported during the monitored period of May through mid-September 2017 (Figs. 135-139).

The biological assessment reported over 50 species from the middle-quality group, and a few from the high- and low-quality groups. The IBI of 1.98 indicated a fair benthic macroinvertebrate community present.

North Walnut Creek Site 977257 (photograph not available) is just over one mile downstream from site 977252. The results were within normal range and similar to the upstream location (Figs. 135-139).

A biological assessment, completed in July 2017, resulted in the largest number of species found from the high-quality group. The IBI of 2.58 indicated a good benthic macroinvertebrate community present.

Figure 132. Walnut Creek Site 977112

Walnut Creek Site 977112 (Fig. 132) is located along the Clive Greenbelt Trail west of 100th Street. There were elevated phosphate levels in mid-January, which coincided with the elevated levels all other areas experienced during this timeframe (Fig. 136). Chloride readings were below the threshold throughout the year (Fig. 138). Nitrate levels reached the drinking water standard (10 mg/L) and 20 mg/L in spring and early summer 2017. Seasonal nitrate averages remained below 9 mg/L (Fig. 135).

A low number of benthic macroinvertebrate species were found for a second year in a row at this site. The IBI result of 1.25 indicated a poor benthic macroinvertebrate community. Only eight benthic macroinvertebrates were found, two from BMI middle-quality group and six from BMI low-quality group, which may indicate some degree of pollution or habitat degradation.

Walnut Creek Site 977147 (Fig. 133) is located along the trail at Colby Woods in Windsor Heights. This site reported normal readings for chloride, phosphate and dissolved oxygen (Fig. 136, 137 & 138). Slightly elevated nitrate readings were reported at the 10 mg/L drinking water standard in September 2016, May and June 2017. A nitrate concentration of 20 mg/L was reported in May 2017 while seasonal averages remained below 9 mg/L (Fig. 135).

No benthic macroinvertebrates were found from the BMI high-quality group, eight from the middle-quality group and 25 from BMI low-quality group at this site. The calculated IBI of 1.24 indicated a poor benthic macroinvertebrate community present and possible habitat degradation.

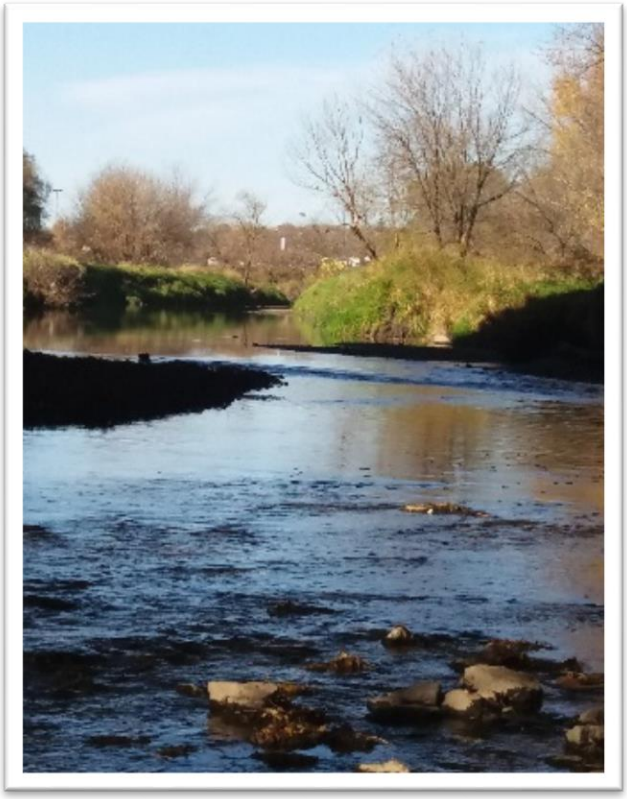

Figure 133. Walnut Creek Site 977147

Figure 134. Walnut Creek Site 977197

Walnut Creek Site 977197 (Fig. 134) is located east of 63rd Street and south of Grand Avenue in Des Moines. This site had normal dissolved oxygen readings (Fig. 137). The pH levels dropped to 5 in January and March 2017. One elevated phosphate reading of 3.0 mg/L was reported in January when all PCCWQMP sites were higher than the 0.6 mg/L threshold (Fig. 136). Nitrate readings were at the drinking standard of 10 mg/L in October 2016, April and May 2017 and reached 20 mg/L in early October 2016. Seasonal nitrate averages remained below 9mg/L (Fig. 135).

Low numbers of benthic macroinvertebrates were found in the BMI middle-quality group and low-quality group. The calculated IBI of 1.58 indicates a poor benthic macroinvertebrate community.

In general, North Walnut Creek and Walnut Creek sites readings fell within safe recreational standards throughout the year. Yearly average levels for North Walnut Creek and Walnut Creek were within the normal ranges.

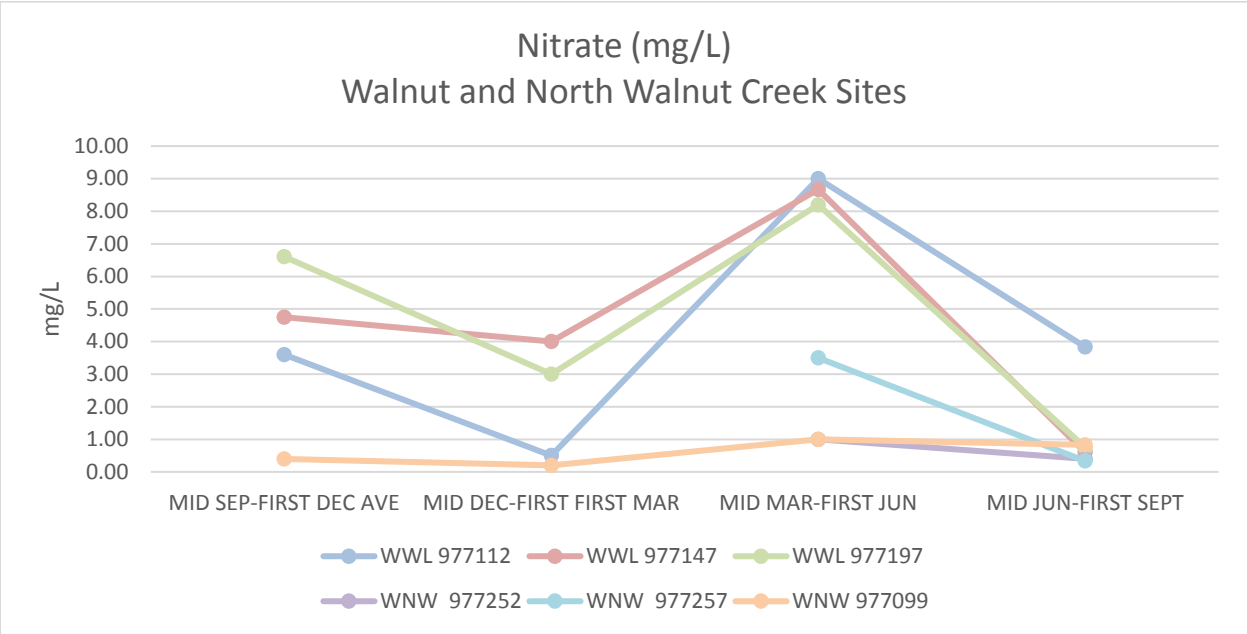

Figure 135. Seasonal Average Nitrate Concentrations for Walnut & North Walnut Creek Sites Mid-Sept. 2016 - Mid-Sept. 2017

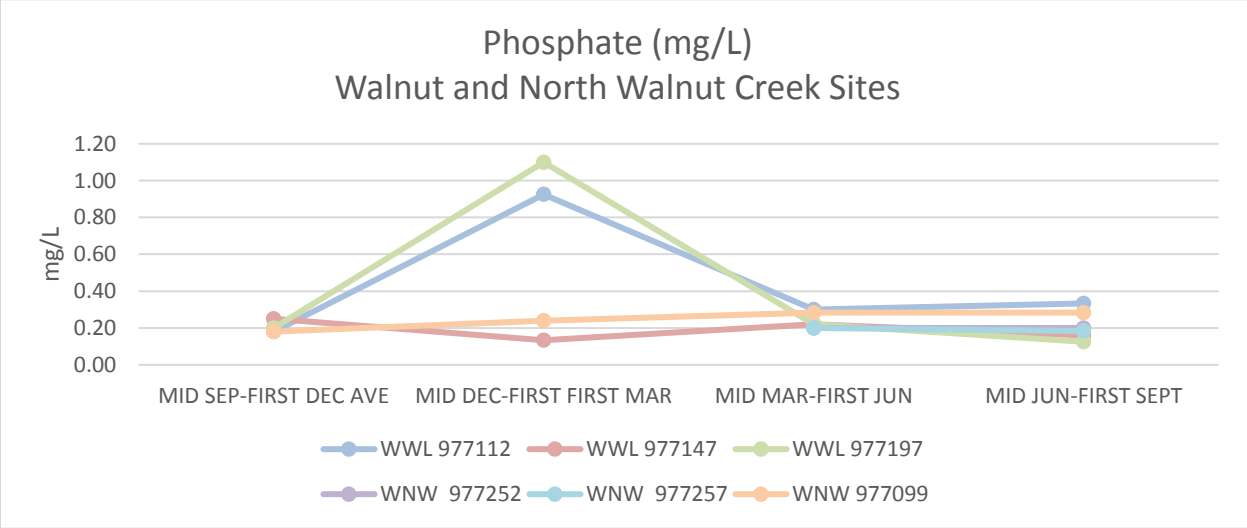

Figure 136. Seasonal Average Phosphate for Walnut & North Walnut Creek Sites Mid-Sept. 2016 - Mid-Sept. 2017

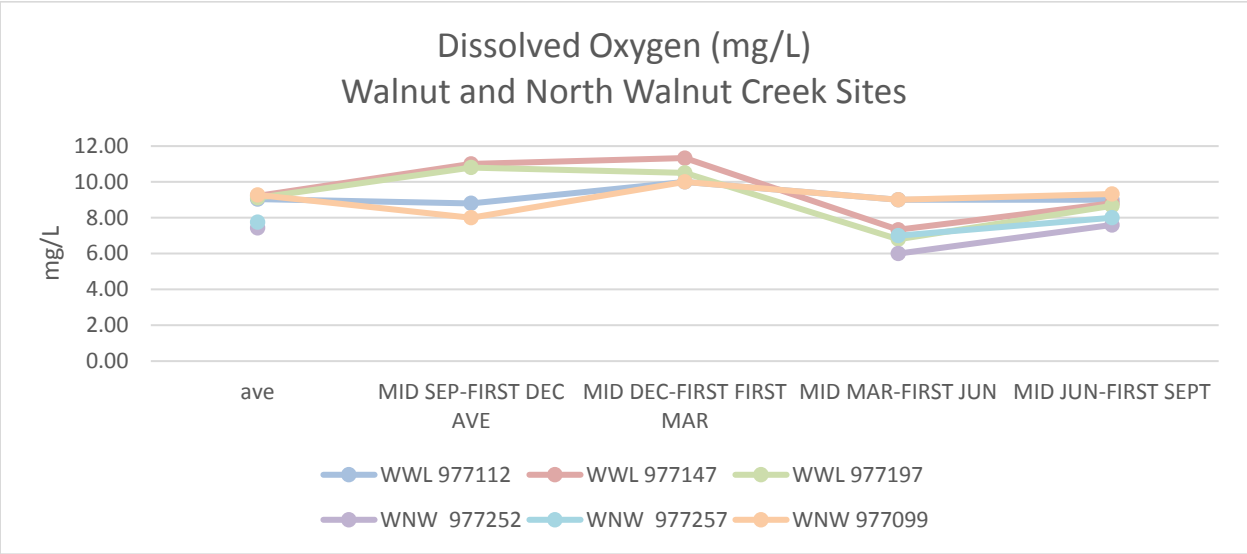

Figure 137. Seasonal Average Dissolved Oxygen for Walnut & North Walnut Creek Sites Mid-Sept. 2016 - Mid-Sept. 2017

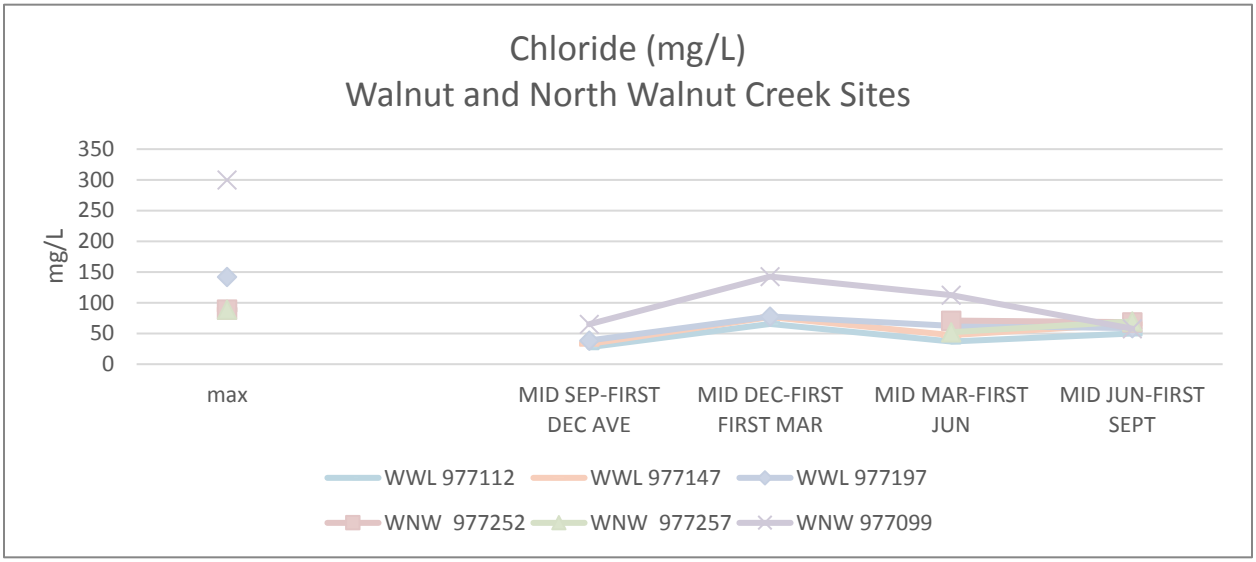

Figure 138. Seasonal Average Chloride Concentrations for Walnut & North Walnut Creek Sites Mid-Sep. 2016 - Mid-Sep. 2017

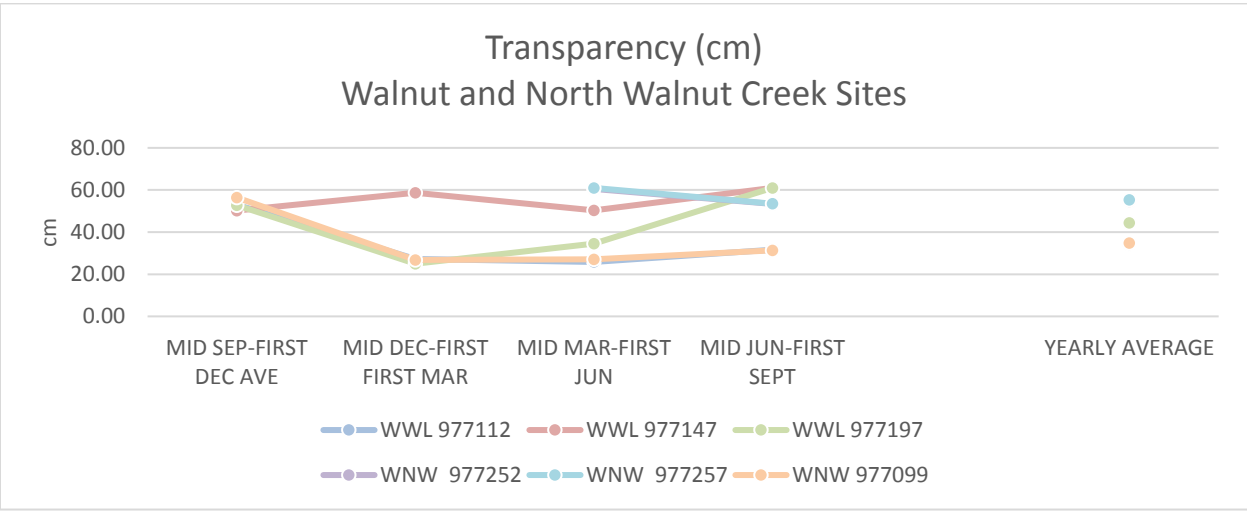

Figure 139. Seasonal Average Transparency for Walnut & North Walnut Creek Sites Mid-Sept. 2016 - Mid-Sept. 2017

Yeader Creek Watershed

Site Number	Creek Name	Site Name
YYD 977273	Yeader Creek	Yeader Creek OP
YYD 977305	Yeader Creek	Yeader Creek - S Union
YYD 977003	Yeader Creek	Yeader Creek
YYD 977117	Yeader Creek	Polk County Snapshot (Site YC2 - Yeader Creek)

Table 12. Yeader Creek Water Quality Monitoring Sites

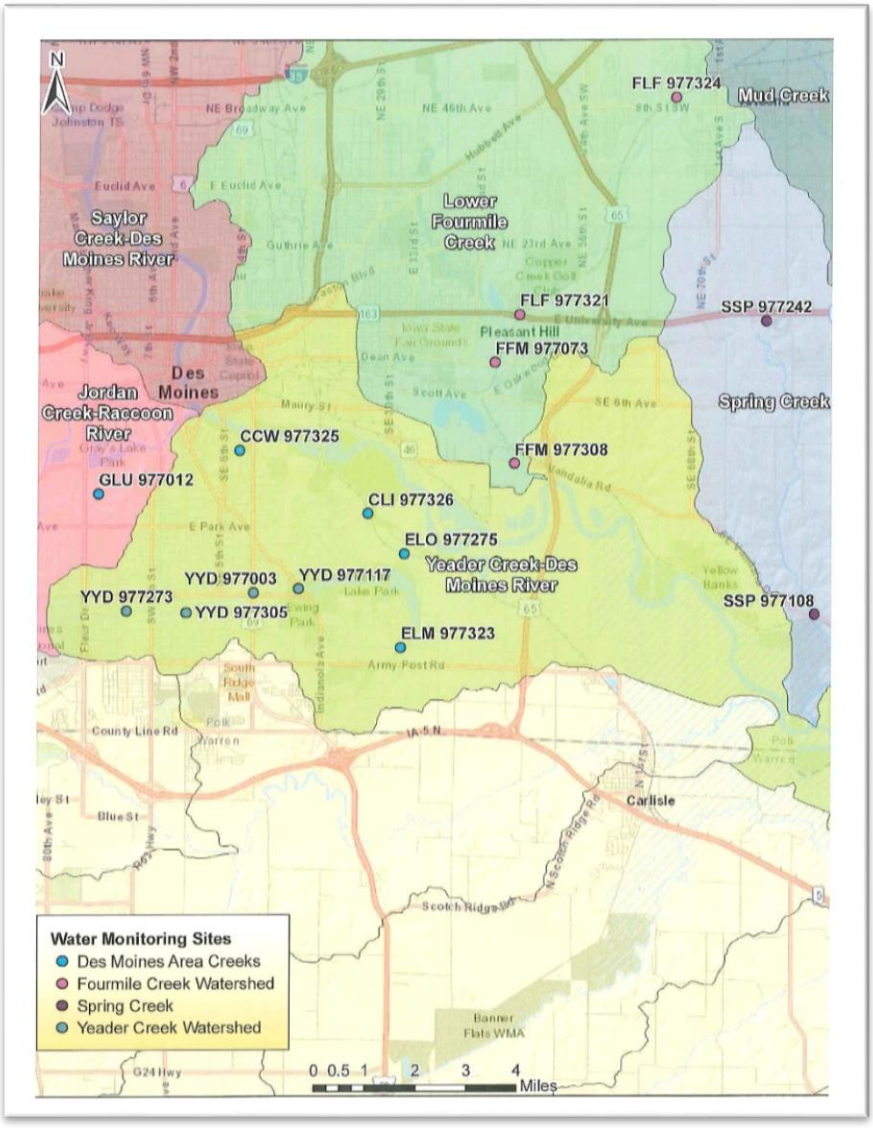

Figure 140. Yeader Creek Water Monitoring Sites

Yeader Creek watershed is a 3,630-acre area of primarily urban residential and commercial land. Four sites along the 3.5-mile stream were sampled (Fig. 140). Site 977273 is approximately one-half mile east of the Des Moines International Airport (Fig. 140). This site is shallow, narrow and shaded. As you travel east along the creek, depth and width typically increase and vegetation along the creek decreases. During this monitoring period however, planned restoration measures at Easter Lake including stream bank stabilization, dredging, shoreline restoration, and public access construction reduced creek depths after the drawdown of lake occurred in January. During this time site 977117, located closest to lake, went dry. Sites were not monitored while iced over in late December 2016 and early January 2017.

Nitrate concentrations at all sites were well below the IOWATER threshold of 20 mg/L and the drinking water standard of 10 mg/L (Fig. 142). The yearly average phosphate reading was 0.4 mg/L at each site, well below normal (Fig. 143). This urban area would likely not experience spikes in phosphate due to agricultural land and lawn fertilizer runoff. Larger lawns in affluent, suburban areas generally have in higher use of lawn fertilizers.

Figure 141. Yeader Creek Site 977273

Dissolved oxygen concentrations dropped to extremely low levels in July 2017. The concentrations dropped as you move along the creek from sites closest to the airport to sites near Easter Lake from 5 to 2 mg/L. The primary water quality concern on Yeader Creek is chloride concentration. Chloride concentrations were well above the IOWATER threshold of 100 mg/L for much of the year (Fig.146). Yearly average chloride concentrations ranged from 119.00 to 135.37 mg/L, well above acceptable concentrations with each site reporting concentrations above 611 mg/L in January 2017. Because elevated levels continue when the winter road and deicing runoff would not be present, the elevated chloride concentrations may be the result of human or animal waste or residual salts in surrounding soils.

Biological assessments were conducted in late July 2017 at all four Yeader Creek sites. No benthic macroinvertebrates were found at site 977305, one benthic macroinvertebrate at sites 977003 and 977273. The biological assessment for site 977117 found eight from the middle-quality group and over 50 from the BMI low-quality group. An IBI of 1.13, calculated for site 977117, indicated a poor benthic macroinvertebrate community present. Yeader Creek is considered an impaired waterway and recreation in the creek is not advised.

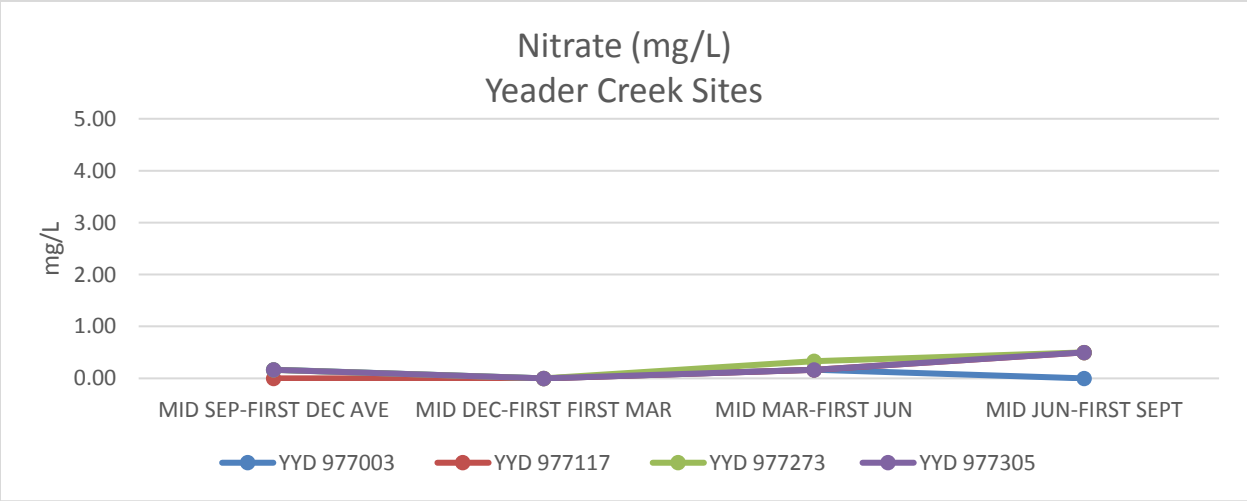

Figure 142. Seasonal Average Nitrate Concentrations for Yeader Creek Sites Mid-September 2016 - Mid-September 2017

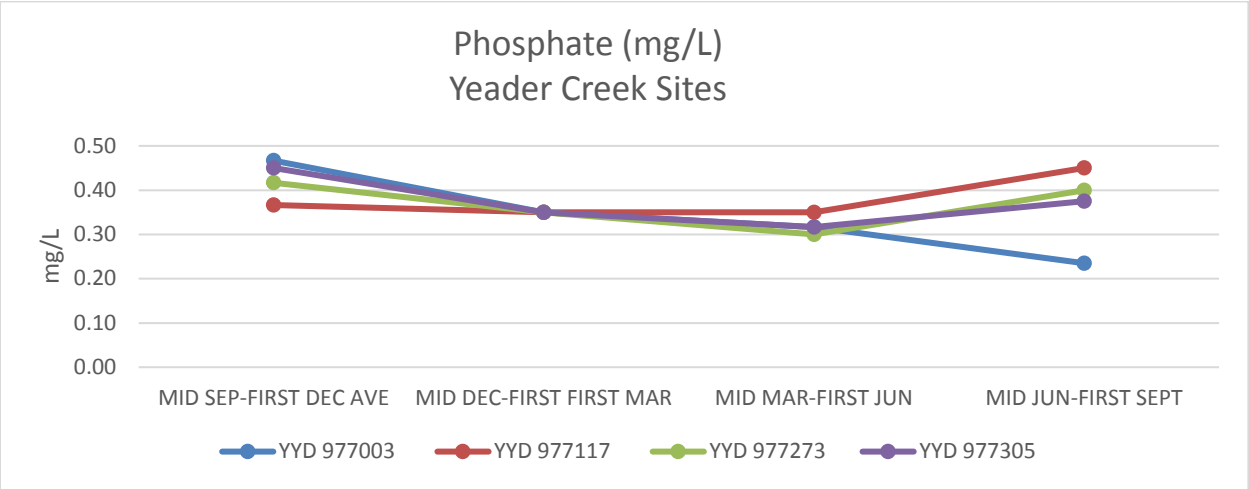

Figure 143. Seasonal Average Phosphate Concentrations for Yeader Creek Sites Mid-September 2016 - Mid-September 2017

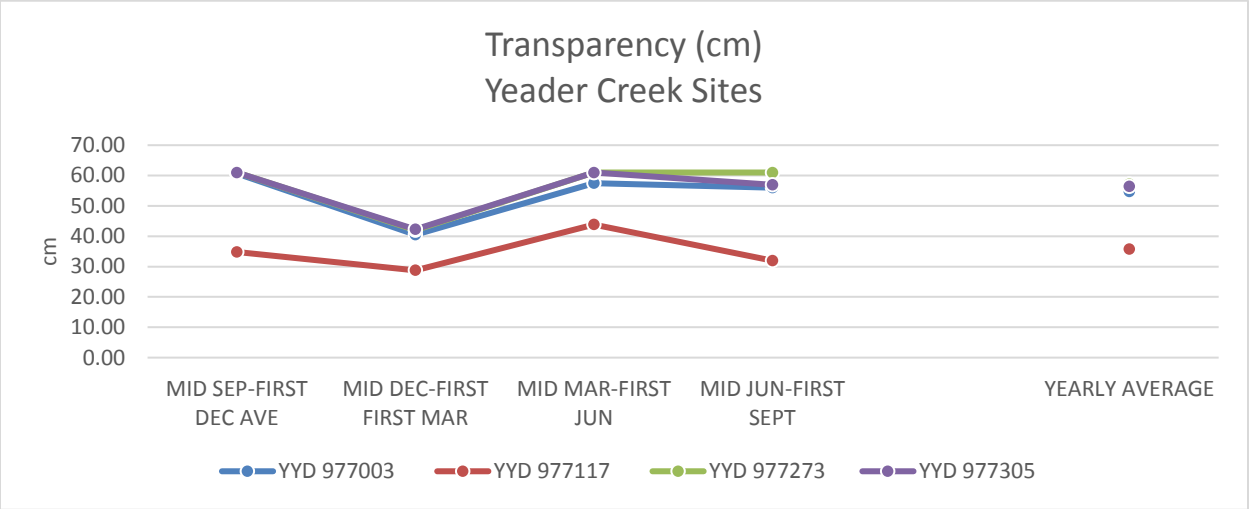

Figure 144. Seasonal Average Transparency for Yeader Creek Sites Mid-September 2016 - Mid-September 2017

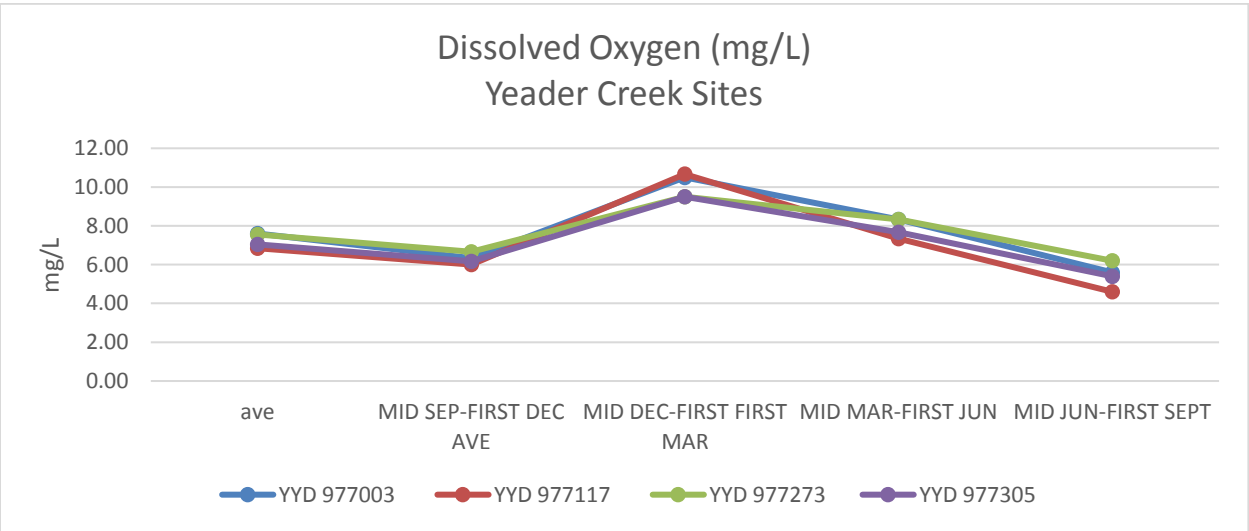

Figure 145. Seasonal Average Dissolved Oxygen Concentrations for Yeader Creek Mid-September 2016 - Mid-September 2017

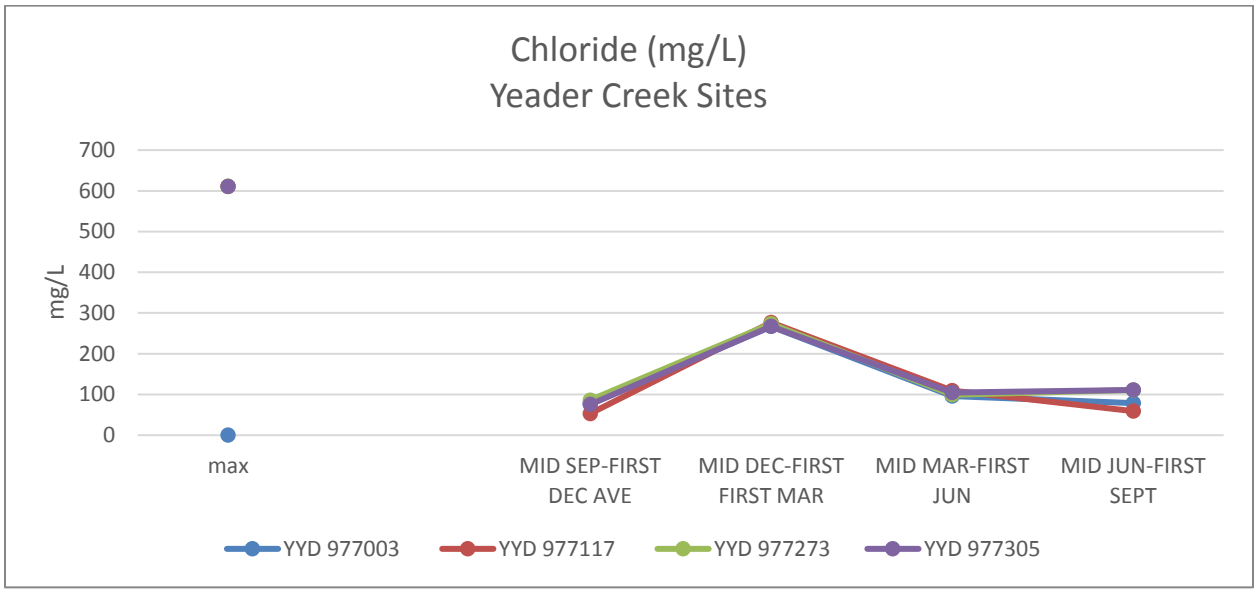

Figure 146. Seasonal Average Chloride Concentrations for Yeader Creek Sites Mid-September 2016 - Mid-September 2017

Summary

In 2017, the Polk County Conservation Water Quality Monitoring Program (PCCWQMP) grew from 32 sites, monitored by Polk County Conservation staff, to 58 sites monitored by staff and volunteers in the summer of 2017. On June 7, 2017, PCCWQMP held a training session with 28 staff from the Cities of Altoona, Ankeny, Des Moines, Johnston, West Des Moines, Des Moines Parks and Recreation and public volunteers in attendance. The city staff and volunteers were trained in IOWATER and PCCWQMP protocols.

PCCWQP field monitors were assigned up to six sites which they visited twice a month throughout the year. Due to safety concerns, not all data was obtained during high water events, icy or unsafe conditions. Field monitors completed 825 chemical/physical assessments, 50 biological assessments and 53 habitat assessments for the 58 sites from mid-September 2016 through mid-September 2017. All chemical/physical assessment data obtained from mid-September 2016 through July 2017 were uploaded to the IOWATER database. The site was disabled in August 2017 as the Iowa Department of Natural Resources discontinued the IOWATER program. Chemical/physical assessment data gathered May 2017 through mid-September 2017 is available to the public on the Environmental Protection Agency's Central Data Exchange at https://www.epa.gov/waterdata/water-quality-data-wqx.

The majority of chemical/physical assessments completed (91.5%) reported a water odor of "none." Water color is correlated with transparency. Sites which reported "clear" water color generally had a transparency of 51-60 centimeters. Transparency results between 51 and 60 centimeters occurred 59% of the time. Higher transparency tended to occur during normal flow when less rainfall runoff occurred. Transparency was the most variable and had the lowest median level during summer and fall of 2017. Drought conditions and high temperatures dominated during this time.

The majority of monitoring site assessments (90%) reported dissolved oxygen concentrations greater than 5 mg/L (normal level). For sites with low dissolved oxygen (5 mg/L or less, 10% of assessments) depressed levels tended to occur most frequently when stream flow was low and water temperatures were at their highest, particularly in July and August 2017 during drought conditions. Dry sites were reported 24 times (3%) throughout the monitoring period.

The majority of chloride concentrations were less than 100 mg/L (93% of the completed assessments). Most elevated chloride concentrations (greater than 100 mg/L) occurred during snowmelt in January through March 2017 and again during low flow in late summer 2017. Maximum chloride concentrations were higher than those reported in 2015-16 with six sites over 200 mg/L, one site over 300 mg/L and four sites with concentrations greater than 611 mg/L.

Elevated chloride concentrations were frequently reported throughout the monitoring period for four sites in Yeader Creek located in an urban area. Other sites reported readings over 100 mg/L once or twice during the season. These include Fourmile, Beaver, Saylor, Camp, Jordan, Mud, Walnut and Little Fourmile Creeks.

Phosphate concentrations were higher than the 2015-2016 monitoring period with 19% of assessment readings at or above 0.6 mg/L. Readings above 0.6 mg/L occurred most frequently in December 2016, January 2017 and again in summer 2017. Maximum readings ranged from 0.2 to 6 mg/L.

Nitrate and nitrite nitrogen concentrations were variable. Nitrate-N was 0 mg/L for 29% of the assessments and 1 to 5 mg/L for 48% of the results. Nearly one quarter of the nitrate results were at or over the drinking water standard of 10 mg/L.

With two years of data, it is not possible to definitively identify trends in water quality or the effectiveness of conservation measures and habitat improvement for any watershed. In 2016, two areas of concern were high chloride levels in Yeader Creek and low dissolved oxygen levels in the drainage ditches near Chichaqua Bottoms Greenbelt. After completion of the 2016-2107 water monitoring period, Yeader Creek sites continue to consistently have high chloride levels even during times of the year when road salts would not be actively entering the system. Bluff Creek and the drainage ditches near Chichaqua Bottoms Greenbelt continued to report low dissolved oxygen levels throughout the year. Unusually high yearly average chloride levels occurred in Camp and North Walnut Creeks during the summer drought. These areas will continue to be closely monitored and assessment data uploaded onto the EPA Central Data Exchange. Abnormal results for many new sites occurred during low creek flows and drought. Most streams tested have sufficient water quality to allow recreational use of these creeks, based on the results of the parameters tested.

Resources

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Appendices

Appendix 1. PCCWQMP Materials and Methods

PCCWQMP follows the IOWATER processes and procedures. IOWATER was a Iowa Department of Natural Resources volunteer water quality monitoring program whose goals are to provide a balanced approach for citizens to become involved in protecting and improving water resources. To develop opportunities for citizens to experience and discover the influence of watershed on water quality and to develop a user-friendly process for data collection and interpretation to increase accurate information on the state's water resources. PCCWQMP trains citizen volunteers to conduct basic water chemical, physical and biological measurements using the IOWATER curriculum. Upon completion of the Workshop, the PCCWQMP Field Monitors receive the IOWATER instruction binder, PCCWAQMP information folder and water monitoring kit. The PCCWQMP will then be responsible for re-supplying the consumable supplies in the kits for all PCCWQMP sites. Field Monitors are assigned to sites within Polk County area.

Polk County Conservation provides water monitoring kits for staff use in the PCCWQP. These include:

- Hach® test strips- pH (50 tests)
- Hach® test strips- nitrate- N /nitrite N (25 tests)
- Hach® titrators- chloride (40 tests)
- Chemetrics® orthophosphate test kit (30 tests)
- Chemetrics® dissolved oxygen test kit (30 tests)
- armored thermometer
- open-reel fiberglass tape measure (100'/30m.)
- transparency tube (with secchi disk)
- meter stick
- a plastic tub
- waste containers
- set of PCCWQMP At-A-Glance quick reference guide cards
- binder with blank forms, IOWATER Benthic Macroinvertebrate Key, personal safety information

All of the chemical/physical test kits have an expiration date located on the bottom of the test strip container and on the color comparators. The chemical/physical assessment sheet includes a reminder to check the expiration date before using the equipment.

The Chemical/Physical Assessment data (pH, dissolved oxygen, water temperature, transparency, nitrate-N, nitrite-N, phosphate) were collected and reported twice per month to Environmental Protection Agency's Central Data Exchange for each site. The collection windows are the first and third week of each month. Polk County Conservation will maintain a database with the monitoring data of the creek site data internally in order to self-monitor the streams.

All parameters use the IOWATER requirements for testing. Details for the IOWATER sampling methods are available in the IOWATER Program Quality Assurance Project Plan (Iowa DNR, 2010).

The PCCWQMP selects testing sites with consideration of the need factors around them, including accessibility of the site, proximity to activities that may alter water quality and for measuring an overall ambient baseline conditions. PCCWQMP, with local organizations and agencies, chooses sites that will provide the most benefit for the betterment of the Polk County watersheds.

Appendix 2. Chemical/Physical Assessment Form

Polk County Water & Land Legacy Bond

POLK COUNTY CONSERVATION

Water Quality Monitoring
Biological Assessment

Date: _____ **Time:** _____ **Site #:** _____

PCCWQMP Monitor: _____ **# of participants:** _____

Others Involved: _____

Was the stream dry when it was monitored? Yes No

If stream was not dry but no benthic macroinvertebrates were found, please record any relevant comments in the Notes/Comments section below.

Biological assessment area: Stream width: _____ m Stream length: _____ m

Benthic Macroinvertebrates (BMI)

High Quality Group *Pollution intolerant*			Middle Quality Group *Somewhat pollution tolerant*			Low Quality Group *Pollution tolerant*		
Tally	# Found	Species	Tally	# Found	Species	Tally	# Found	Species
		Caddisfly			Alderfly			Aquatic Worm
		Dobson Fly			Backswimmer			Black Fly
		Mayfly			Crane Fly			Bloodworm
		Riffle Beetle			Crawdad/Crayfish			Flatworm
		Snail (not pouch)			Crawling Water Beetle			Leech
		Stone Fly			Damselfly			Midge Fly
		Water Penny Beetle			Dragonfly			Mosquito
Total:					Giant Water Bug			Pouch Snail
					Limpet			Rat-tailed Maggot
Notes/Comments:					Mussels/clams			Water Scavenger Beetle
					Orb Snail	**Total:**		
					Predaceous Diving Beetle			
					Scud			
					Sowbug			
					Water Boatman			
					Water Mite			
					Water Scorpion			
					Water Strider			
					Whirligig Beetle			
			Total:					

Collection time (Circle ONE): **0-15 minutes** **15-30 minutes** **30-45 minutes** **45+ minutes**

Identification confidence level (How confident are you that your identification is correct?):

____I am not sure
____Some are correct; I am not sure of others *(Please clarify this in the notes section)*
____I think they are correct
____I'm fairly confident they are correct
____I guarantee they are correct

Polk County Conservation Water Quality Program
Ginny Malcomson, Program Coordinator
11407 NW Jester Park Drive
Granger, IA 50109
515-323-5300, F: 515-323-5354
Ginny.Malcomson@polkcountyiowa.gov

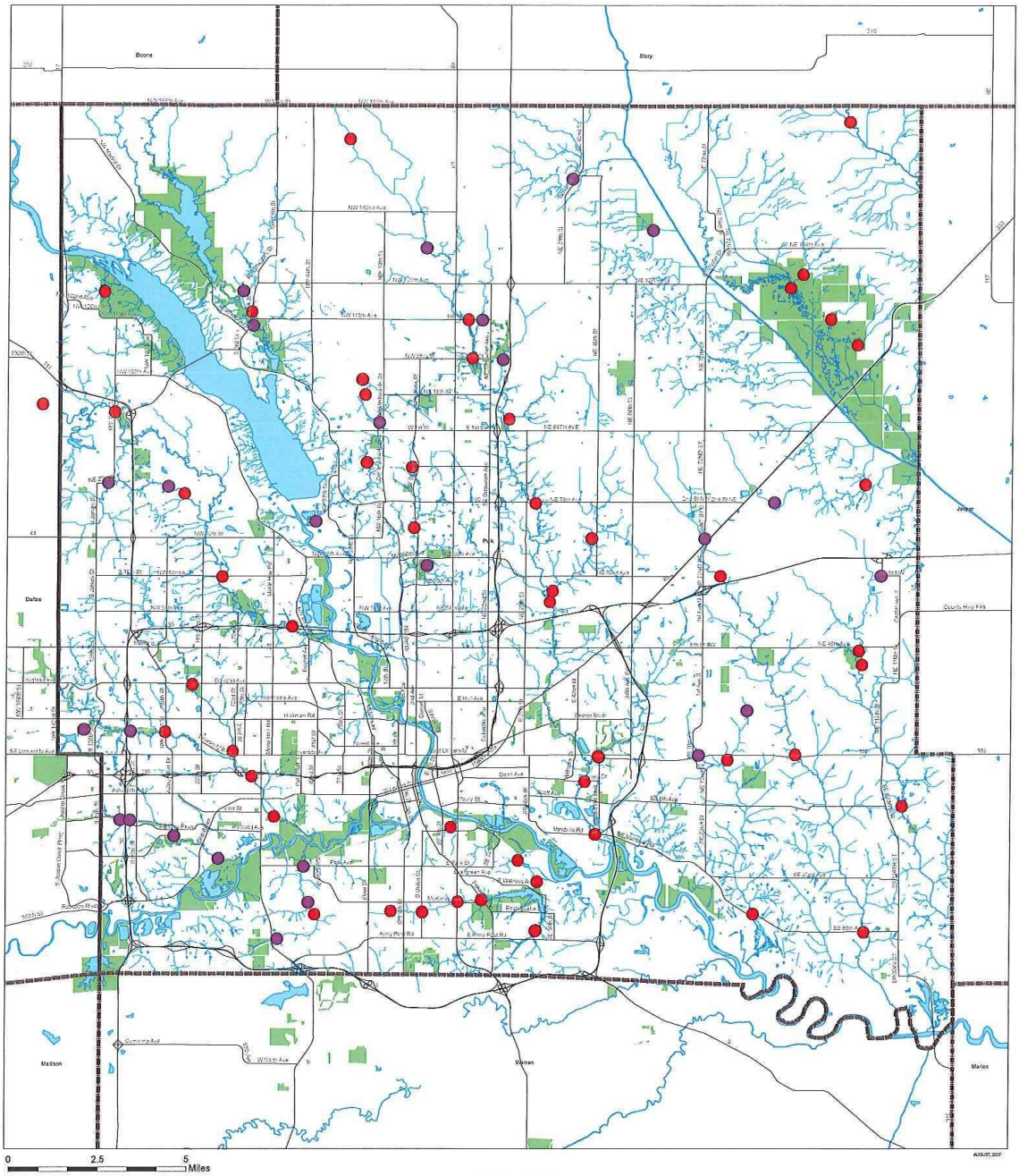
IOWATER Volunteer Water Quality Monitoring

Appendix 3. PCCWQMP Site Locations

Site ID	Watershed/Area	Creek	Site Name
BBV 925036	Beaver Creek	Beaver Creek	Beaver Creek Snapshot (Site 18 - Beaver Creek)
BBV 977120	Beaver Creek	Beaver Creek	Beaver Creek Snapshot (Site 19 - Beaver Creek)
BBV 977125	Beaver Creek	Beaver Creek	7100004 - Des Moines River - Lizard Creek
BBV 977160	Beaver Creek	Beaver Creek	Polk County Snapshot (Site Beaver Creek at Prairie Point)
BLB 977121	Beaver Creek	Little Beaver Creek	Beaver Creek Snapshot (Site 20 - Little Beaver Creek)
BBG 977192	Big Creek	Big Creek	Big Creek – Through Polk City Park/Refuge
CCM 977066	Camp Creek	Camp Creek	Polk County Snapshot (Site CC1 - Camp Creek)
CCM 977067	Camp Creek	Camp Creek	Polk County Snapshot (Site CC2 - Camp Creek)
CCM 977152	Camp Creek	Camp Creek	Camp Creek/Thomas Mitchell Park
CLI 977326	Case Lake	Case Lake Inflow	Case Lake Inflow
C04 977310	Chichaqua Area	Drainage Ditch	DD4 - Control Marsh
C38 977311	Chichaqua Area	Drainage Ditch	Drainage Ditch 38
CBL 977306	Chichaqua Area	Bluff Creek	Bluff Creek - 118th
CCR 977307	Chichaqua Area	Carney Creek	Carney Creek at Buttonbush
CCW 977325	Crawford Creek	Crawford Creek	Crawford Creek at SE 9th
ELM 977323	Easter Lake	Magnolia Creek	"Unnamed Creek" at Three Lakes Estates
ELO 977275	Easter Lake	Unnamed	Easter Lake Outlet
FDR 977309	Fourmile Creek	Fourmile Creek Trib-Deer Cr	Deer Creek
FFM 977072	Fourmile Creek	Fourmile Creek	Polk County Snapshot (Site FMC1 - Fourmile Creek)
FFM 977073	Fourmile Creek	Fourmile Creek	Polk County Snapshot (Site FMC10 - Fourmile Creek)
FFM 977075	Fourmile Creek	Fourmile Creek	Polk County Snapshot (Site FMC3 - Fourmile Creek)
FFM 977078	Fourmile Creek	Fourmile Creek	Polk County Snapshot (Site FMC6 - Fourmile Creek)
FFM 977079	Fourmile Creek	Fourmile Creek	Polk County Snapshot (Site FMC7 - Fourmile Creek)
FFM 977301	Fourmile Creek	Fourmile Creek	4 Mile Creek
FFM 977308	Fourmile Creek	Fourmile Creek	4 Mi Creek - Vandalia Av
FFM 977312	Fourmile Creek	Fourmile Creek	Muchiknock Creek at 4Mi Creek
FLF 977321	Fourmile Creek	Little Fourmile Creek	Little Fourmile Creek at E University in Pleasant Hill
FLF 977324	Fourmile Creek	Little Fourmile Creek	Little Fourmile Creek at Lyons Park
FFR 977082	Frink Creek	Frink	Near GWT and SW 42nd
GLU 977012	Gray's Lake	Unnamed Creek-Into Gray's Lake	Unnamed Creek - Trib. to Grays Lake
IIN 977327	Indian Creek	Indian Creek	Indian Creek at NE 162nd Av
JPW 977300	Jester Park - Paw Creek	Paw Creek	Paw Creek
JPW 977313	Jester Park - Paw Creek	Paw Creek	Paw Creek-Golf Course Fork
JJR 977029	Jordan Creek	Jordan Creek	Jordan Creek
JJR 977085	Jordan Creek	Jordan Creek	Polk County Snapshot (Site JC1 - Jordan Creek)
JJR 977150	Jordan Creek	Jordan Creek	Jordan Creek 2 - Barker Lemar
JJR 977270	Jordan Creek	Jordan Creek	Jordan Creek at Walking Trail Bridge
MMD 977302	Mud Creek	Mud Creek	Mud Creek NW of Runnells
MMD 977303	Mud Creek	Mud Creek	Mud Creek - NE 62nd
MMD 977304	Mud Creek	Mud Creek	Mud Creek - NE 12th Av

RRC 977104	Rock Creek	Rock Creek	Polk County Snapshot (Site RC1 - Rock Creek)
RRC 977105	Rock Creek	Rock Creek	Polk County Snapshot (Site RC2 - Rock Creek)
RRO 977196	Rock Creek	Rock Creek	Ankeny-Woodward Bike Trail & Rock Creek
SSN 977322	Santiago Creek	Santiago Creek	Santiago Creek at Bridge Near NE 82nd Ave
SSY 977106	Saylor Creek	Saylor Creek	Polk County Snapshot (Site Saylor Creek)
SSY 977189	Saylor Creek	Saylor Creek	N of Prairie Trail At Magazine
SSP 977108	Spring Creek	Spring Creek	Polk County Snapshot (Site SC2 - Spring Creek)
SSP 977242	Spring Creek	Spring Creek	Spring Creek (PH Site 6)
WNW 977252	Walnut Creek	N Walnut Creek	North Walnut Creek Downstream of Tributary, North of Hickman Rd
WNW 977257	Walnut Creek	N Walnut Creek	North Walnut Creek DS of Trib (Storm Sewer), N of Univ. Blvd.
WNW 977099	Walnut Creek	Walnut Creek	Polk County Snapshot (Site NWC3 - North Walnut Creek)
WWL 977112	Walnut Creek	Walnut Creek	Polk County Snapshot (Site WC3 - Walnut Creek)
WWL 977147	Walnut Creek	Walnut Creek	Walnut Creek at Colby Park
WWL 977197	Walnut Creek	Walnut Creek	Walnut Creek at North Valley Drive
YYD 977003	Yeader Creek	Yeader Creek	Yeader Creek
YYD 977117	Yeader Creek	Yeader Creek	Polk County Snapshot (Site YC2 - Yeader Creek)
YYD 977273	Yeader Creek	Yeader Creek	Yeader Creek OP
YYD 977305	Yeader Creek	Yeader Creek	Yeader Creek - S Union

Appendix 3. Map of PCCWQMP Sites



2017
PCCWQMP Monitoring Sites

In order to record accurate results, **REMOVE SUNGLASSES** during monitoring.

Safety First

Use caution when entering a stream, making sure the current is not too strong and bottom will support you.

POLK COUNTY CONSERVATION

515-323-5300

Dissolved Oxygen

Typical range: 8.7-12.9 mg/L;
IA ave. 10.5 mg/L
Retest <5mg/L (warm streams)

Nitrate/Nitrite

Typical range:
3 to 8.5 mg/L (rivers);
0.05 to 0.94 mg/L (lakes)

IA ave. = 5.8 mg/L (rivers);
0.07 mg/L (lakes)

Phosphate

Typical range: 0.11-0.34 mg/L (rivers); 0.05 -0.13 mg/L (lakes)
IA ave. = 0.2 mg/L (streams);
0.08 mg/L (lakes)

Chloride

Typical range: 16 - 29 mg/L
IA ave.= 22 mg/L (rivers)

Stream Water Temperature (Biweekly)

Record temperature after 2 minutes.

pH (Biweekly)

Facing upstream, along transect with greatest flow. Dip test strip and remove immediately, do not shake. Read in 15 seconds. Record data. Dispose in trash.

Typical range: 8.0-8.4
Retest if <6.5 or >9.0

Dissolved Oxygen (Biweekly)

Facing upstream, along transect with greatest flow, rinse 25 ml sample cup 3 times. Lower cup to wrist depth while holding it upside down. Turn the opening downstream so cup backfills with water. Turn upstream and carefully remove cup and water sample from stream. Gently tip to pour off excess water. Place ampoule in cup and snap off tip. Allow ampoule to fill with water and slowly mix ampoule water. Compare color **after 2 minutes**. Record data in mg/L. Dispose in trash.

Nitrate/Nitrite (Biweekly)

Facing upstream, along transect with greatest flow. Dip test strip and remove immediately, do not shake.

Hold strip level, pad side up for **30 seconds**. Record **NITRITE** (pad on right)
Hold level for an **additional 30 seconds** and record **NITRATE** reading (pad on tip of strip).
Dispose in trash.

Phosphate (Biweekly)

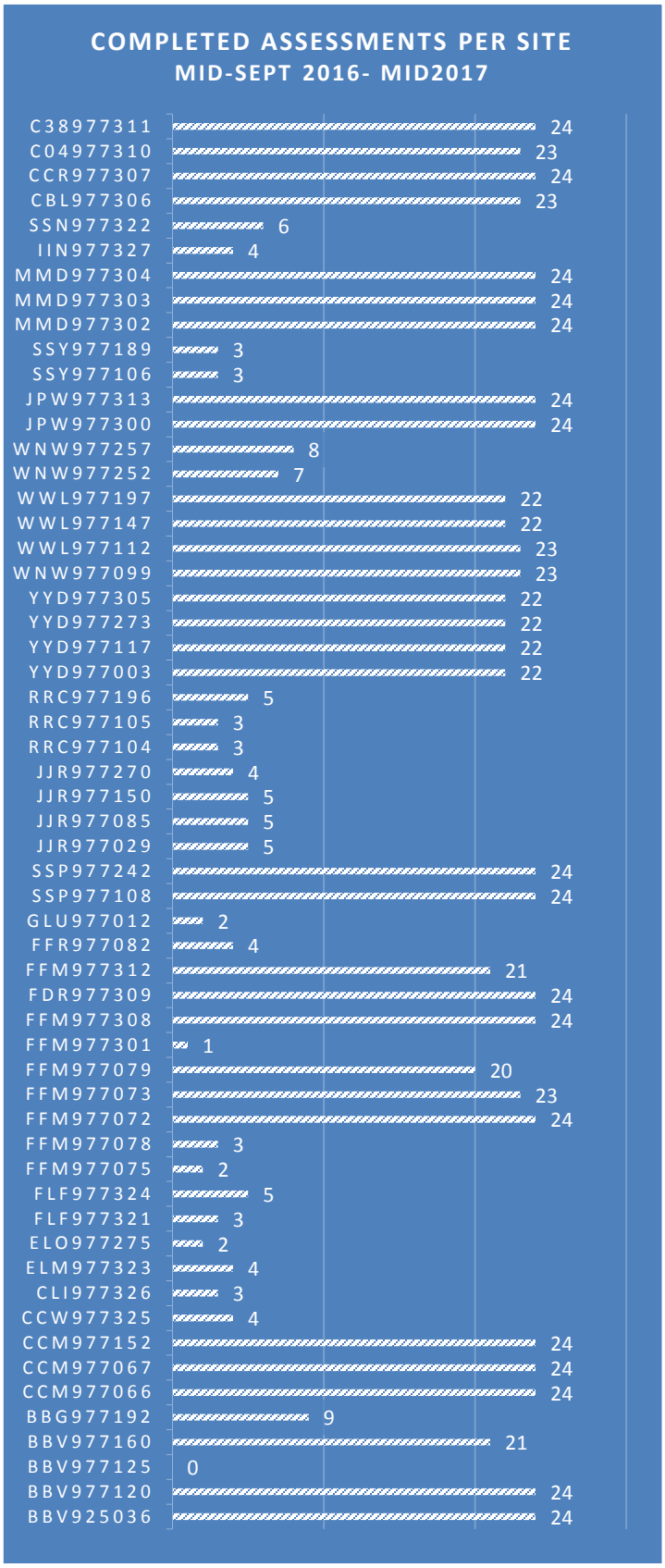
Facing upstream, along transect with greatest flow rinse 25 ml sample cup **3 times**. Lower cup to wrist depth while holding it upside down. Turn the opening downstream so cup backfills. Turn upstream, carefully remove water sample from stream. Gently pour off excess water. **Add 2 drops** of Activator Solution, **cap and shake**. **Place ampoule** in cup and snap off tip. Allow ampoule to fill with water. **Slowly mix** ampoule water. Compare color **after 2 minutes**. Record data in mg/L. Dispose water in household drain and ampoule in trash.

NOTE: KEEP SUPPLIES OUT OF SUN

Chloride (Biweekly)

Facing upstream, along transect with greatest flow rinse 25 ml sample cup **3 times**. Fill cup to 25 ml mark. Remove a titrator strip from bottle. *Replace cap immediately*. Insert bottom of titrator into CL sample cup. Do not allow the yellow string at top to become submerged. Allow titrator wick to become completely saturated. There is no time limit– the reaction is complete when yellow string turns dark-**about 5-10 min.**

Appendix 5. Additional Results



C38-Drainage Ditch 38
C04-Drainage Ditch 4
CCR-Carney Creek
CBL-Bluff Creek
SSN-Santiago Creek
IIN-Indian Creek
MMD-Mud Creek
SSY-Saylor Creek
JPW-Paw Creek
WWL-Walnut Creek
WNW-North Walnut Creek
YYD-Yeader Creek, RRC-Rock Creek
JJR-Jordan Creek
SSP-Spring Creek
GLU-Unnamed creek near Gray's Lake
FFM-Fourmile Creek
FDR-Deer Creek tributary of Fourmile Creek
FLF-Little Fourmile Creek
ELO-Easter Lake Outlet
ELM-Easter Lake - Magnolia Creek in Three Lakes Estates
CCW-Crawford Creek
CCM-Camp Creek
BBG- Big Creek
BBV-Beaver Creek

Figure 147. Assessments Completed per Site Mid-September 2016 through Mid-September 2017

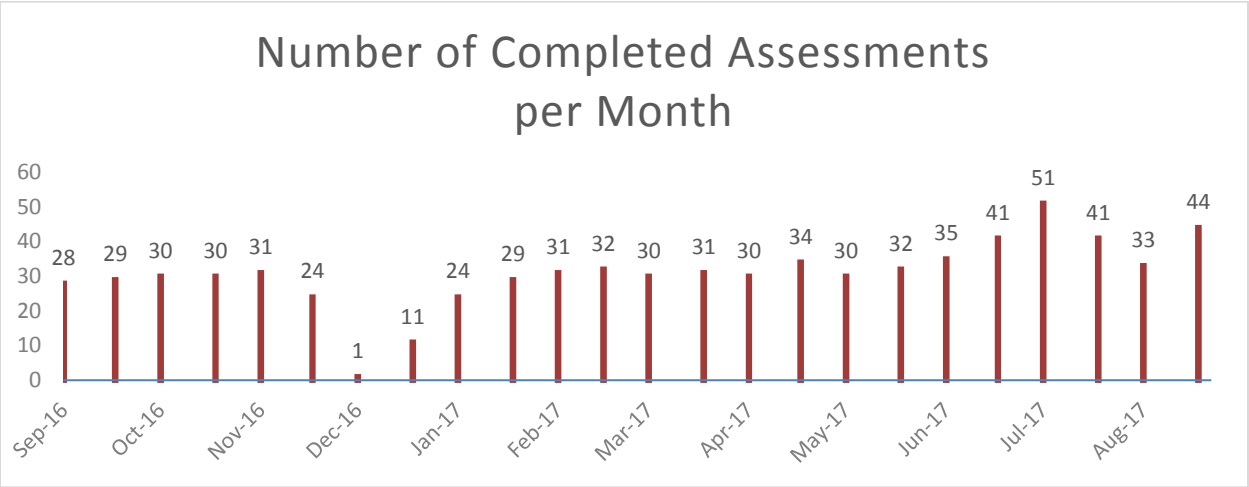
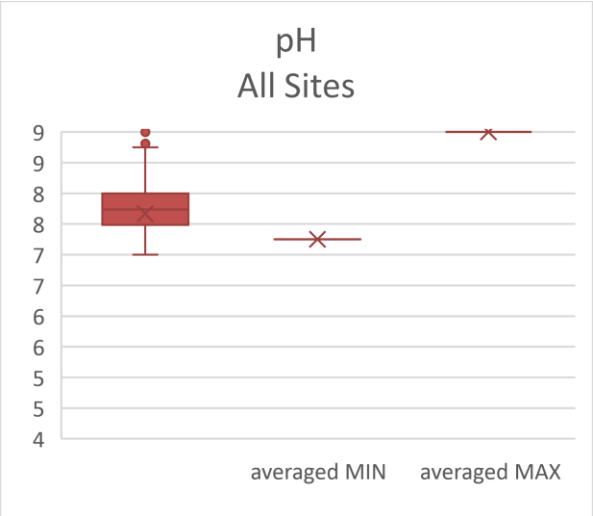
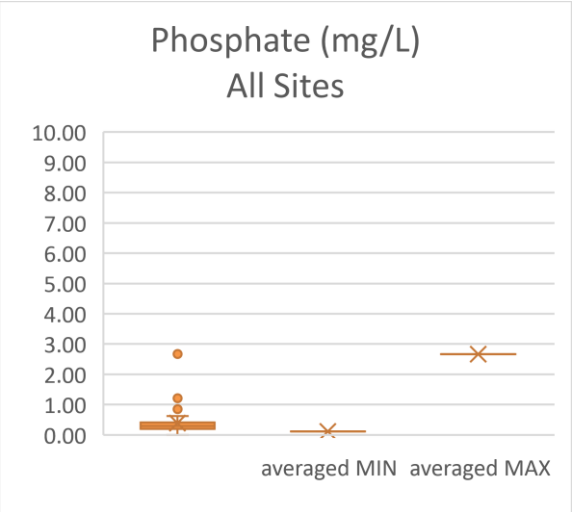
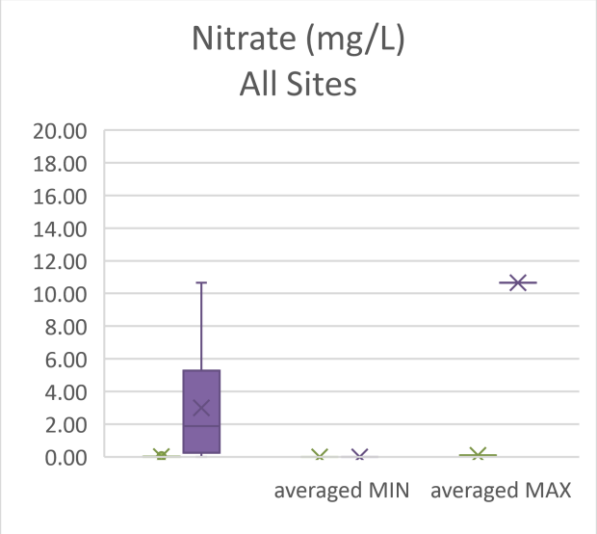
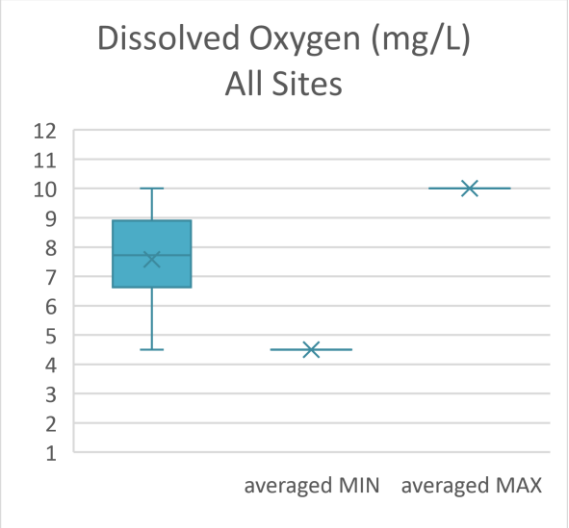


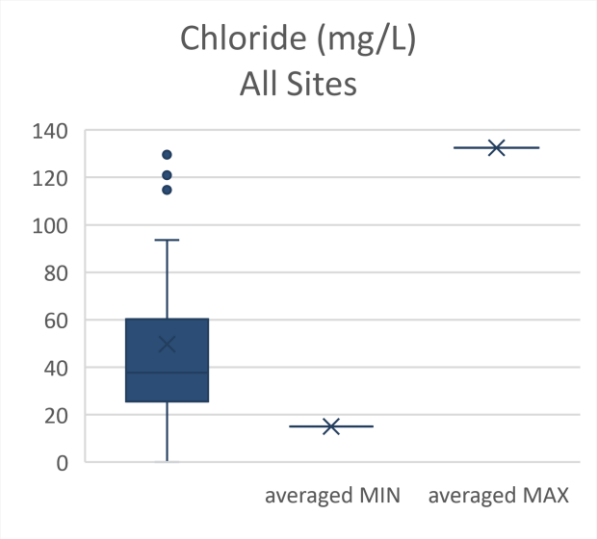
Figure 148. Completed Assessments Mid-September 2016 Through Mid-September 2017. Normal Monitoring per Month is First and Third Weeks of the Month.

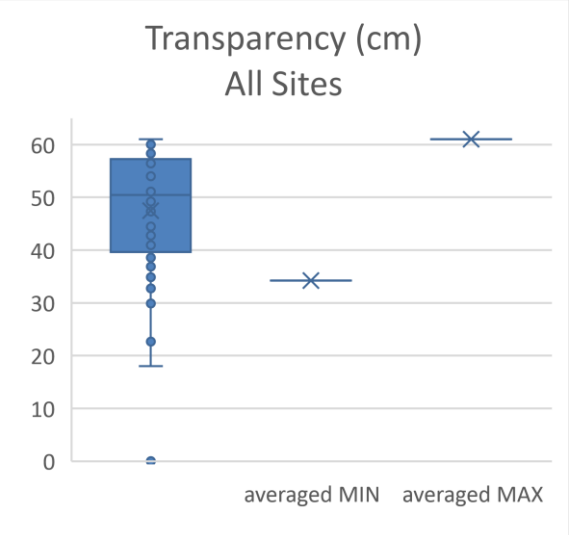

pH
All Sites
9
9
8
8
7
7
6
6
5
5
4
averaged MIN
averaged MAX


Phosphate (mg/L)
All Sites
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
averaged MIN
averaged MAX


Nitrate (mg/L)
All Sites
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
averaged MIN
averaged MAX


Dissolved Oxygen (mg/L)
All Sites
12
11
10
9
8
7
6
5
4
3
2
1
averaged MIN
averaged MAX


Chloride (mg/L)
All Sites
140
120
100
80
60
40
20
0
averaged MIN
averaged MAX


Transparency (cm)
All Sites
60
50
40
30
20
10
0
averaged MIN
averaged MAX